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Economic Contributions of the Apple Industry Supply Chain in New York State

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EXECUTIVE SUMMARY

In order to define appropriate firm, industry, and public policy strategies to strengthen opportunities for economic development and improve the competitiveness of the New York State (NYS) apple industry, it is essential to understand the economic contributions and evolving linkages among agricultural producers, intermediary agents and processors, and downstream buyers. To help preserve and expand the opportunities for more productive correspondence with the wider economic development community, we provide state-level analyses within the various apple industry supply chain sectors, as well as in aggregate. Data from federal and state sources are utilized, along with primary data collected with assistance from the New York Apple Association and the Lake Ontario Fruit Team of Cornell Cooperative Extension). The data are carefully analyzed to discuss a variety of economic metrics, assess inter-industry linkages, and calculate economic contributions to the NYS economy

U.S. apple producers harvested 10.4 billion pounds in 2016, with approximately 61% of the crop produced in Washington, 10% in New York, and 9% produced in Michigan. NYS production was nearly 1.2 billion pounds and valued at over $317 million. The crop is roughly split 50-50 between fresh market and processed uses; however, an increasing proportion of the crop has migrated to fresh markets in recent years (i.e., 56% in 2016). Fresh apple receive higher prices than those dedicated for processing, such that 80% of total apple receipts were from fresh market sales in 2016. While weather induced supply shocks exist, farm production of apples continues to trend upward, even in the face of decreased acreage. Shifts to alternative production systems with higher density plantings are evident.

Economic changes in apple processing over time were examined via economic data (from 2002 to 2012 census years) on the fruit and vegetable canning industry in NYS. Overall, the industry is continuing its recent trends of consolidation and contraction, as the number of establishments have declined, along with the size of the workforce. The value of total ouput and capital investments also exhibited relatively strong reductions over this time period (in constant dollar terms). Relative to competitor states, Michigan's processing industry withnessed strong growth over this same period, while Pennsylvania and Washington exhibited strong contraction. In Washington, establishment numbers and employees had declines (on a percentage basis) greater than those in New York. The implied reductions in payments to owners was 40% over this time period, only New York's reduction of 55% was larger.

A comprehensive definition of the apple industry in NYS was constructed to include apple producers, processors (frozen, canned, wine, cider), support service providers (packing, grading, storage), and apple-centric public research activities. A customized economic input-output model was developed to assess economic contributions of individual and aggregate industries across a number of metrics. In 2016 dollars, the aggregate NYS apple industry directly contributes $1.3 billion in total output, 8,033 jobs, and $397.9 million in gross domestic product (GDP) to the New York State economy. When backward-linked supply chain business-to-business transactions (indirect effects) and household spending out of labor income (induced effects) are considered, these values grow to $2.1 billion, 11,872 jobs, and $853.1 million, respectively. The results imply relatively strong multiplier effects for the industry, whereby every $1 of direct output in the apple industry generates an additional $0.58 in backward linked (non-apple) industry output, every direct job generates an additional 0.48 jobs, and every $1 of direct GDP generates an additional $1.14 in GDP from related business activity in the state. Individual supply chain sector estimates reveal strong economic linkages between apple industry firms in the state.

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INTRODUCTION

In order to define appropriate firm, industry, and public policy strategies to strengthen opportunities for economic development and improve the competitiveness of the New York State (NYS) apple industry, it is essential to understand the economic contributions and evolving linkages among agricultural producers, intermediary agents and processors, and downstream buyers. To help preserve and expand the opportunities for more productive correspondence with the wider economic development community, we provide state-level analyses within the various apple industry supply chain sectors, as well as in aggregate. Data from multiple federal, state and local sources, informed by primary data collection efforts, are carefully analyzed to discuss a variety of economic metrics, assess inter-industry linkages, and calculate economic contributions to the state, along with the corresponding multiplier effects.[2]

Policymakers, industry leaders, and economic development professionals are often confronted with a set of fundamental questions about agriculture-based economic development and its potential to support and/or enhance the economic vitality of communities. These questions are equally aligned with considerations specific to the apple industry in the state. Some of these questions include (Schmit 2016):

1. How do efforts to grow agricultural industries play into mainstream economic development efforts?
2. Are there unexploited opportunities to boost performance in agricultural sectors?
3. What types of programs or policies would support increases local multiplier effects for agricultural industries via expanding import substitution and/or exports?
4. How can educators, industry leaders, and public agencies intervene with agricultural firms in ways that lead to cumulative improvements in economic activity and overall impact?

Answers to these types of questions are elusive, often due to inadequate information and data to address them in an informed and comprehensive manner. Structural changes in the farm and food industry in general, and the apple industry in particular, continue as agricultural producers and associated intermediary agribusiness firms adapt to changing economic conditions, consumer preferences, and technological advancements. Given that structural relationships and market opportunities and challenges within the economy change over time, revisiting these issues regularly is important. This report provides the most recent assessment of apple industry trends and economic contributions in NYS.

The report continues with a discussion of current descriptive statistics of the apple industry, including state-level trends, based on currently available federal- and state-level secondary data, and in comparison to New York's primary competitor states. This is followed by a description of the methodological approach used for the multi-sector analysis, including a description of the specific apple supply chain sectors included, and how the direct economic measures of these sectors were estimated. The empirical economic contribution results follow, along with a decomposition of the multiplier effects by industry. We close with some implications of the results and summary conclusions.

[2] The original proposal included regional contribution estimates, based on the major apple growing regions in NYS, conditional on data availability. Two issues prevented this from being completed. First, regional estimates would, by definition, consider all spending by within-region firms to industries outside of that region (but still in NYS) as leakage and would not contribute to impact. Conceptually, this presents issues as to whether these geographical regions define well established economic regions and whether the results are meaningful in the context of this project. Second, survey response rates for primary data collection were insufficient to estimate individual regional impacts with any degree of confidence. If desired, regional impacts can be approximated by applying the state-level contribution multipliers to regional data.

DESCRIPTIVE ANALYSIS AND INDUSTRY TRENDS

INDUSTRY OVERVIEW

Apples are grown throughout the world. Total world production is estimated to have grown by 44 percent between 2000 and 2015, with approximately 85.0 million metric tons produced in 2015. China doubled its production over this time period and now accounts for approximately one-half of the world's apple production (43.1 million metric tons). Production for the remainder of the world is estimated to have increased 8.5 percent during a similar time frame (O'Rourke 2016). The United States holds a strong second position, producing 4.6 million metric tons, compared to Turkey and Poland with 2.7 and 3.3 million metric tons, respectively (O'Rourke 2016). More recently, the U.S. Department of Agriculture reported that U.S. apple producers harvested 4.7 million metric tons (10,417 million pounds) in 2016 (USDA 2017a). U.S. apple growers produced slightly less in 2015 (10,172 million pounds), with 61% of the crop produced in Washington, 10% in New York, and 9% produced in Michigan. Combined, the top three apple-producing states produce over 80% of apples harvested in the United States. If New York was a country unto itself, it would rank in the top 30 apple producing countries in the world (WAPA 2014).

Total sales of U.S. apples in 2014 was $2.9 billion, with sales value by state closely aligned with production. In particular, 66% of apple sales in 2014 were from Washington, followed by New York at 9% and Michigan at 8% (USDA 2017a). Sales of New York State (NYS) apples in 2015 was $274.5 million, an increase of $30 million over the previous year. The increase in sales can be attributed to an increase in production of 100 million pounds and an average price increase from $0.200 per pound in 2014 to $0.203 in 2015 (USDA 2017b). The volume of fresh market apples rose 14% from the previous year to 715 million pounds that more than offset a 4.4% decline in price (to $0.293 per pound) to return positive sales growth over the prior year. The quantity of processed apples rose from 635 million pounds in 2015 (up 1.6%), with an average sales price per ton up 8.3% ($205) over the prior year. (USDA 2017b)

Several factors contribute to the ability of a particular area to be competitive in producing apples throughout the world. New York State is fortunate in that the soils and climate support the production of the apple crop. The production sector is of sufficient size and scale to attract suppliers of purchased inputs such as chemicals, fertilizers, lumber, steel, irrigations systems, and wind machines. Handling facilities are available to store, pack, and process the crop. Public infrastructure, such as the energy grid, internet access, and the interstate highway system allow the crop to move expeditiously from farm to processor or storage facility and, subsequently, to the consumer. The industry is relatively close to local ports, including New York City, Newark, Boston, and Philadelphia.

Labor availability for apple farms is mixed. Some producers and packing facilities rely on a local labor force, while much of the pruning and harvest is done by hand by workers who come from outside of the United States. Many growers utilize the H2A guest worker program as a means to secure a legal labor force. Local banks and Farm Credit Associations are available to provide capital for expansion. The industry benefits from the research and extension activities conducted through Cornell University and Cornell Cooperative Extension. For example, the Cornell apple breeding program housed in the New York State (NYS) Agriculture Experiment Station in Geneva, New York is one of three such programs in the entire United States. Entrepreneurs can utilize the resources of the Cornell Food Venture Center and Food Science Department to develop new products for the market place. Furthermore, extension education programs with strong emphases on apple production include the Lake Ontario Fruit Team, the Eastern New York Commercial Horticulture Program and Harvest New York.

Public-private partnerships are important to the NYS apple industry. The NYS Department of Agriculture and Markets (NYSDAM) administers the NYS Apple Marketing Order (AMO, 1 NYCRR Part 201) and the NYS Apple Research and Development Program (ARDP, 1 NYCRR Part 204), both funded by assessments on producers and processors in the state. The AMO provisions consider advertising, promotion, publicity, marketing and product research of apples and apple products. The ARDP is responsible in funding research on apple production, harvesting, storage, and marketing quality research. The two programs include advisory boards consisting of apple growers, packers, and storage operators. Grower referendums must take place at least once every six (ARDP) or eight (AMO) years to vote on renewal or discontinuation of the programs and set assessment rates.

Throughout history, farmers have joined together for the purpose to solve a problem shared by all or to pool resources that would benefit the industry. The apple industry shares a similar heritage. In 1935v Eastern New York and New England apple growers joined together to form the New York/New England Apple Institute to promote consumption of fresh-market apples. The Western New York Apple Growers Association was formed to promote apples produced in Western New York in 1950. Both groups worked to create the NYS Apple Marketing Order. The New York/New England Apple Institute voted to disband in 1994 and the Eastern New York growers and Western NY Growers Association united to create the New York Apple Association (NYAA). Since 1994, NYSDAM has contracted with the NYAA to expend funds collected via the AMO. The NYAA board of directors consists of 15 growers who represent six growing regions across NYS (**Appendix A**).

New York State government policy has recently been important to apple industry efforts. In particular, Governor Cuomo has recently announced that funding will be made available to construct a state-of-the-art, 120,000 square-foot food hub in Hunts Point, NY. In addition, the farm cideries legislation that went into effect in 2014 allows farm cideries to manufacture and sell hard cider made from crops grown in NYS. Governor Cuomo's *Taste NY* program also promotes the NYS apple industry at thruway rest stops and in *Taste NY* stores. The NYSDAM has regulatory responsibilities as well, including working with the USDA to issue phytosanitary certificates to meet import and quarantine requirements of other states and foreign nations.

NEW YORK STATE APPLE PRODUCTION

Over the past 35 years, apple production in NYS has trended upward, albeit with large variation in particular years around that trend line (**Figure 1**). Extreme cold and frost during the bud and blossom stage can significantly impact crop yields. Apple growers (and fruit farmers in general) experienced roller-coaster temperatures in 2002 resulting in a significant loss in production compared to previous years. Production fell from 940 million pounds in 2001 to 630 million pounds in 2002, a 49% decrease. The crop was again negatively impacted by weather events decreasing production from 1,220 million pounds in 2011 to 720 million in 2012.

Similar to other agricultural production sectors, the number of farms with apple acres has declined over time. Specifically, the number of operations declined 12% between 1997 and 2012, from 1,557 to 1,365, including a modest increase from 2007 to 2012 farms (**Figure 2**). Attrition in farm numbers can be explained, in part, on economies of scale, but also relative to global market changes (e.g., China's large increase in apple plantings in the late-1990s that are now in full production). Indeed, increased supplies of global apple juice concentrate has had a decreasing impact on farm-level apple prices. In these cases, marginal farms exit the industry, while some orchards are purchased by other farmers, and other low procuring orchard lands are abandoned.

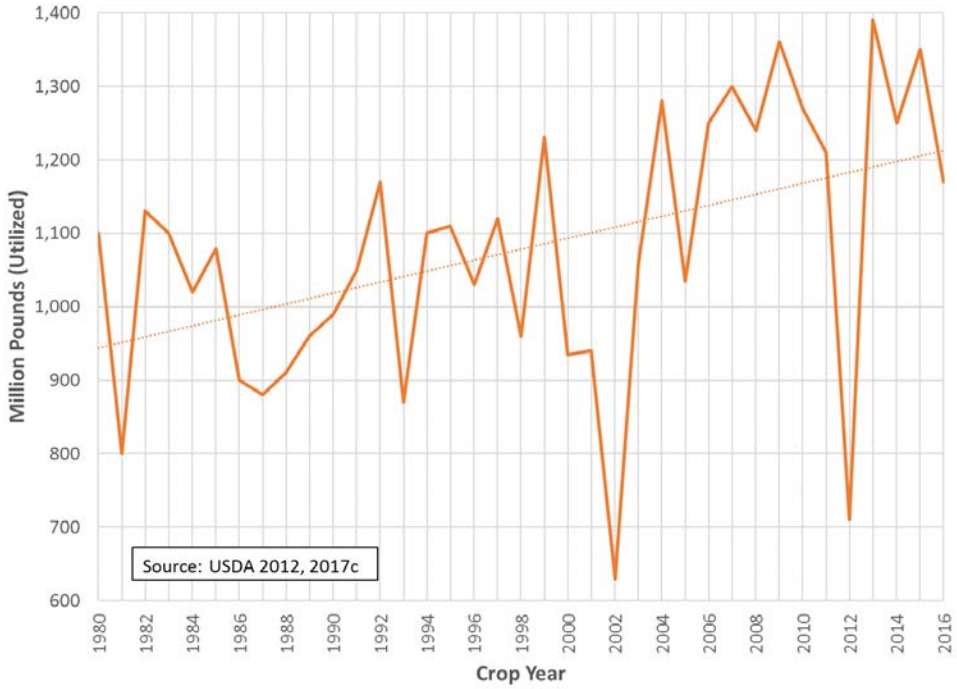

Figure 1: Annual apple production utilized, New York, 1980 – 2016.

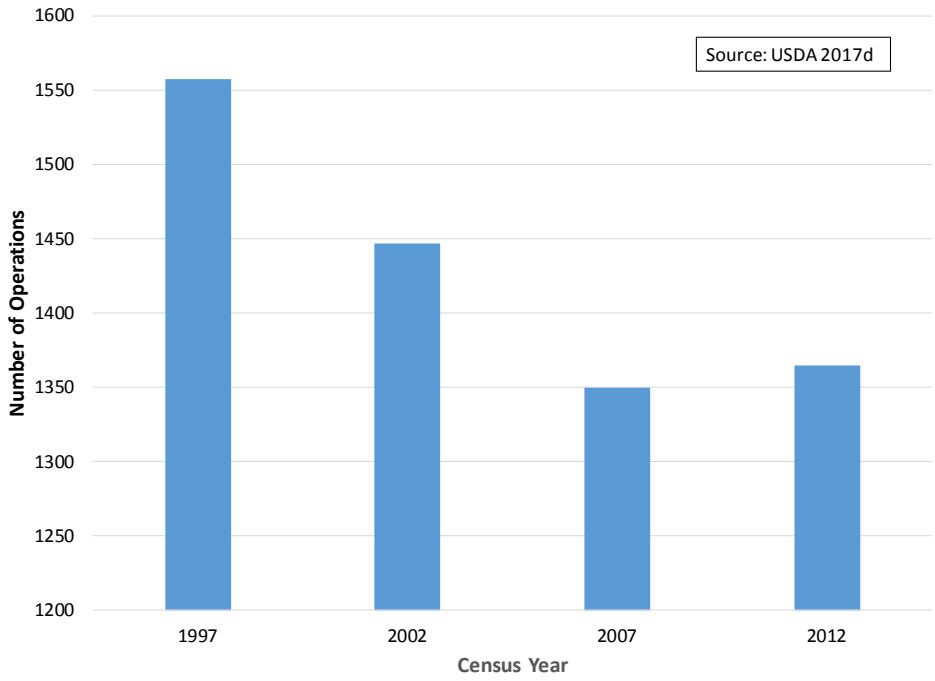

Figure 2: Farms operations with apple acres, New York, 1997 – 2012.

While some apple acres are maintained in production when some farms exit, the overall number of acres has decreased substantially since the late 1990s. Between 1997 and 2012, apple acreage has decreased almost 30% in NYS, from 66 to 47 thousand acres (**Table 1**). While some land may have been removed

from active production, based on total agricultural acreage in NYS over this same time period, most of the apple acreage decline has transitioned to other (presumably more profitable) crops. The most significant decrease in apple acres occurred between 1997 and 2002 with an average annual decrease 4%. Between 2002 and 2012 the average annual decrease was more modest at just over 1% per year. The adoption of innovative cultivation techniques, planting of new varieties, and new technology adoption have resulted in an upward trend in production in spite of a decrease in acreage.

Table 1. Number of New York apple farms and apple acres.

	1997	2002	2007	2012
Number of farms	1,557	1,447	1,350	1,365
Total acres	66,055	53,233	49,966	47,148
Bearing acres	(N/A)	46,994	44,916	41,027
Nonbearing acres	(N/A)	6,238	12,880	6,121

Source: USDA (217d). N/A = not available

Individual apple farm sizes range from less than 1 acre to more than 1,000. While the predominance of farms are small, production is dominated by larger farms (**Figure 3**). In particular, based on the 2012 Census of Agriculture, over 70% of farms in NYS have under 15 acres of apples, but contribute just over 6% of total apple acres in the state (USDA 2017d). Conversely, only 10% of the farms have more than 100 acres of apples, but those 10% make up nearly 70% of total apple acres in production. This dynamic is not unique to NYS, nor unique to most agricultural production sectors. Indeed, the strength of larger commercial-scale orchards provides smaller farmers access to suppliers of farm inputs and markets for their output.

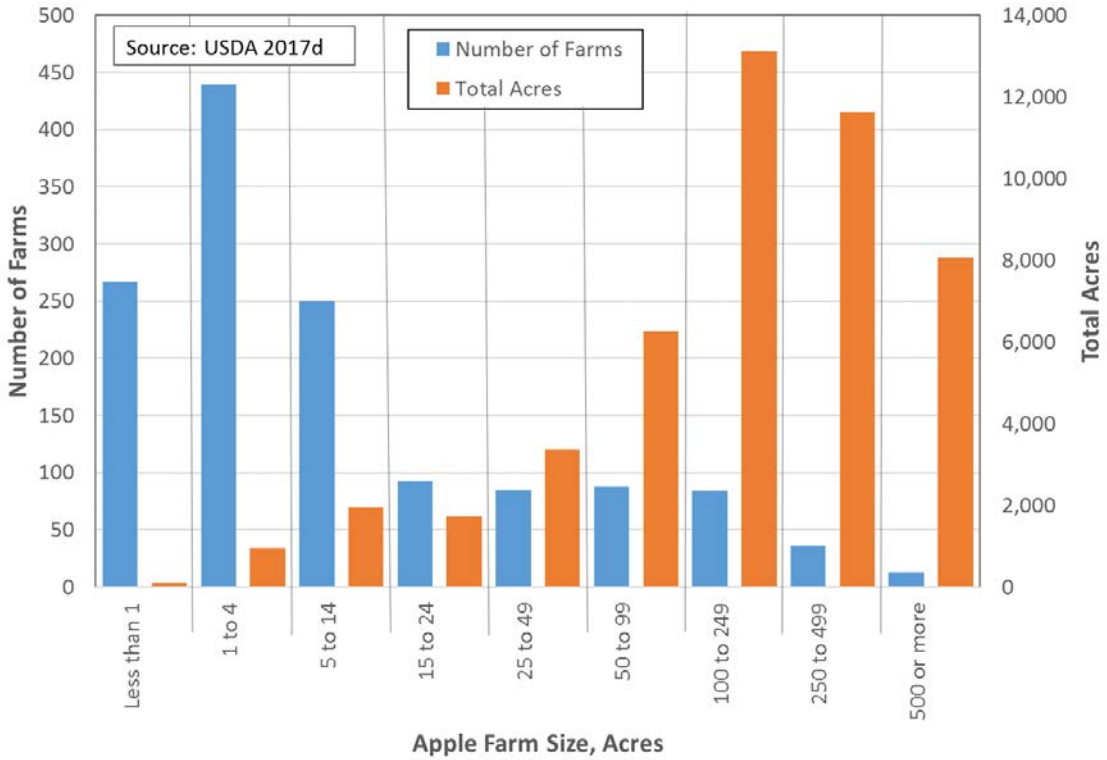

Figure 3: Farms operations with apple acres, New York, 1997 – 2012.

COSTS OF PRODUCTION – FARM LABOR

The labor force on apple farms is mixed. Farms have both year-round and seasonal employees. Employees may be family members, local residents, or sourced from countries outside of the United States. Some are exempt (salaried) employees, while others are hourly and/or paid by piecework. The industry relies on offshore labor to work within the orchards and has been challenged by ongoing farm labor shortages. Harvest platforms are viewed as one means to improve efficiency of labor when pruning apple trees as well as thinning and harvesting the crop (Ifft, Freedland, and Wells 2017). Based on the 2015 *Fruit Farm Business Summary*, labor costs (direct and indirect costs) make up, on average, 47.9% of all operating expenses (Lake Ontario Fruit Team 2017) on NYS apple farms, or $2,855 per bearing acre.

Several studies have been published recently from Cornell University focused on farm labor issues in New York State (e.g., Telega and Maloney 2010, Maloney et al. 2015, Baker et al. 2015, Maloney et al. 2016, Ifft and Karszes 2016, and Maloney and Eiholzer 2017). Baker, et al. (2015) is particularly insightful in describing the labor force on NYS apple farms, where the authors summarize6 the results of a grower survey conducted in 2014. The survey was administered to members of the NYAA who had hired labor in their farm operations. Three-fourths of the reporting farms (*N* = 98) were located in Central and Western New York (average size of 154 acres) and 16% were located in Eastern New York (average size of 76 acres). Respondents were relatively evenly distributed across farm sizes (based on acres), with approximately one-half reporting a 3-year average annual harvest of less than 50,000 bushels and one-third an average of more than 100,000 bushels. Farms from Central and Western NY sold apples as both fresh market and processed, while nearly 75% of the farms from Eastern NY sold fresh market apples only. The number of seasonal workers grow, as expected, with farm size; however, more than proportional increases in reliance on seasonal H2A workers is apparent (**Figure 4**). Of note, only 28% of the seasonal labor force was employed during harvest only. Those staying beyond harvest season performed hand operations such as pruning, thinning, and tying, etc. (Baker et al. 2015).

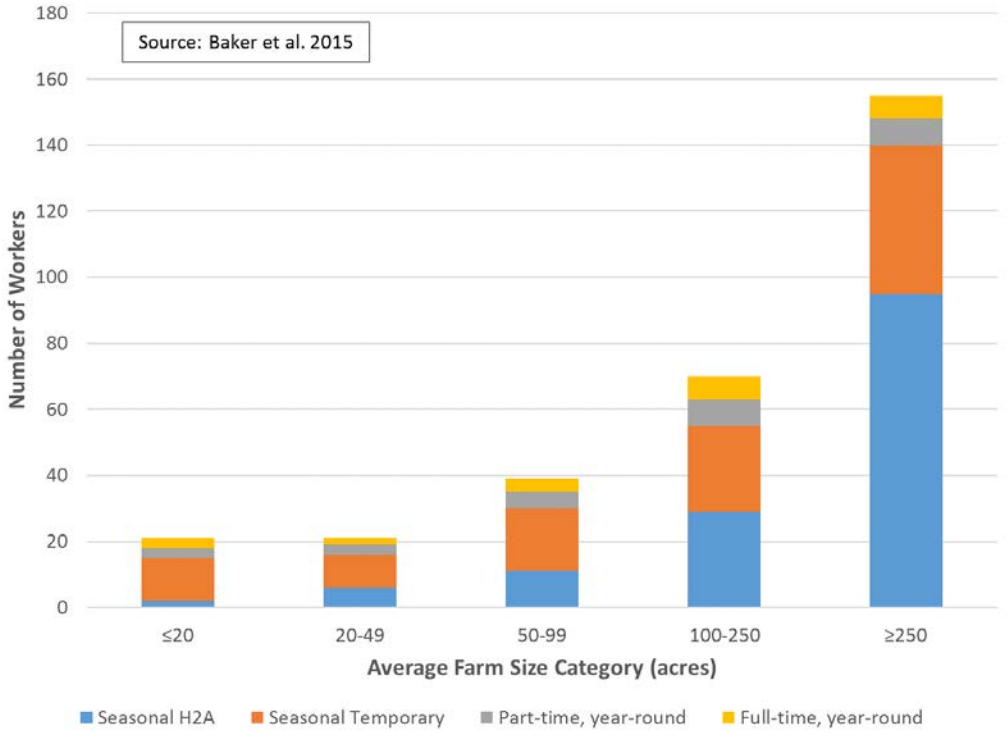

Figure 4: Distribution of farm labor usage on apple farms in New York, by labor type and farm size.

COST OF PRODUCTION – CROP INPUTS

Next to labor, the cost of chemical inputs is the second largest cash operating expenditure for NYS apple farms. Based on a 2015 data, 17.6% of total cash operating expenditures were for chemical inputs, or $1,052 per bearing acre (Lake Ontario Fruit Team 2017). Other costs include insurance, utilities, interest, and professional/technical services at $541 (9.1%), equipment expenses (fuel, oil, trucking, maintenance, leasing) at $481 (8.1%), real estate costs (repairs, taxes, and leasing) at $407 (6.8%), supplies and marketing expenses at $398 (6.7%), and purchases of fruit for resale at $232 (3.9%). Total cash operating expenses, including labor, were $5,966 per bearing acre in 2015.[3] In summary, total accrual revenue per bearing fruit acre was estimated to be $8,196, compared to total accrual expenses of $6,604 (Lake Ontario Fruit Team 2017).

COST OF PRODUCTION – PRODUCTION SYSTEMS

The number of apple farms and acres in apple production have declined over the past 3 decades, while overall apple yields has continued to increase. In 1990, NYS apple farms averaged 98 trees per acre; in 2011, this number was 277, on average (Baker et al. 2015). Generally, orchardists use one of four production systems, with newer systems utilizing higher density plantings (**Table 2**). As one would expect, higher density systems come with higher establishment costs, but factors related to length of time to full bearing, yields per acre, and maintenance costs must be examined to assess relative profitability (MSU 2017). Existing land use, orchard year, and varieties also come into play. However, new orchards tend to be established on tall spindles or fruiting walls to minimize time to full-bearing years and to build labor efficiencies through use of pruning and harvesting platforms.

Table 2. Comparison of apple production systems.[1]

	Cost per Acre				
System	**Establishment**	**Maintenance**	**First FB year**	**Trees/acre**	**FB Yield (bu)**
Central Leader	3,179	1,542	8	182	650
Vertical Axe	10,351	1,845	6	622	800
Tall Spindle	17,395	2,067	4	1,210	1000
Fruiting Wall	16,754	1,849	4	1,089	1200

Source: MSU 2017

[1] FB = full bearing. Average annual maintenance costs per acres are computed based on annual maintenance costs each year, up to and including the first FB year.

VARIETIES

Varietal mix impacts prices paid to farmers, farm profitability, and the cost of harvest. Red and Golden Delicious apples are grown throughout the world. These varieties are challenged as consumer preference grows for Gala, Fuji, and Jonagold. Varieties such as Cortland, Empire Macoun, and Jonagold were developed by Cornell University to thrive in the unique climate conditions of NYS. Growers throughout the United States tend to grow multiple varieties to satisfy the interest of consumers, as well as other agronomic considerations. Most varieties grown in NYS support the fresh market. Indeed, fresh market varieties account for almost 80 percent of the entire U.S. apple crop (USApple 2016). In terms of acreage, around 68% of harvested acres in the 2015 apple crop was utilized for fresh market. Those not sold for fresh market are be sold for canning, juice, cider and other processed uses.

[3] The Fruit Farm Business Summary for 2015 reported that 10% of all fruit acres were non-bearing for 2015 (*N* = 14). This percentage has ranged from 9% to 14% since 2011 (Lake Ontario Fruit Team 2017).

Dual-purpose varieties are expected to represent 12% of U.S. production in 2016, and 35% of the crop harvested in the eastern U.S. (USApple 2016). The distribution of varieties continues to evolve. Red Delicious still leads varietal production in the country, with Gala in second place and gaining (**Table 3**). Change in varieties is slow to evolve because of the cost to plant new orchards, years to full bearing, and the productive life expectancy of existing orchards. Club varieties have also entered the market place in recent years. Examples of NYS club varieties include Snapdragon® and Ruby Frost®. Cornell University partnered with Crunch Time Apple Growers, a grower-owned company of 145 members, to establish an exclusive licensing agreement in North America for the two apple varieties. Growers pay royalties on trees purchased, acreage planted, and fruit produced. Income from the royalties is used to market new varieties and support the Cornell University apple-breeding program. Club varieties tend to be planted in high-density orchards and command a premium price in the fresh market.

Table 3. Total U.S. apple production, thousand bushels, by variety (000).[1]

VARIETIES	2011	2012	2013	2014	2015	2016 FORECAST
Red Delicious	54,156	53,132	56,950	62,262	50,360	53,152
Gala	34,544	36,279	36,951	45,323	37,498	43,978
Granny Smith *	19,290	22,808	21,140	24,523	22,923	21,949
Fuji *	18,767	24,209	22,378	27,402	20,155	22,823
Golden Delicious	23,842	23,305	27,292	26,871	22,149	20,697
Honeycrisp	6,922	7,636	9,631	13,591	13,217	15,296
McIntosh	10,617	6,286	11,577	10,703	11,201	10,008
Rome	8,555	5,335	9,435	8,217	8,194	7,815
Cripps Pink *	3,574	4,587	4,236	5,688	6,942	6,862
Empire	6,366	3,228	6,938	6,221	6,447	6,002
York	3,910	4,214	3,910	4,040	4,200	3,876
Idared	4,178	1,520	4,974	4,318	4,234	4,322
Jonathan	3,208	1,262	3,552	3,013	2,990	2,952
Cortland	3,172	1,842	3,046	2,590	2,714	2,447
Braeburn *	2,868	2,695	2,489	3,098	2,179	1,868
Northern Spy	1,545	389	1,440	1,141	1,122	1,295
Stayman	1,031	949	1,030	1,016	1,039	945
Jonagold *	1,122	1,507	1,383	1,500	977	893
Cameo *	942	1,184	1,110	957	519	596
All Others	15,796	11,735	18,909	19,696	19,128	20,248
Total	**224,405**	**214,102**	**248,371**	**272,171**	**238,189**	**248,024**

[1] Source: USApple (2016). Used with permission, U.S. Apple Association, M. Seetin, editor.
*Includes only Western production. Eastern and Midwest production included in All Others.

COMPARISON OF MAJOR APPLE PRODUCTION STATES

NYS ranks second in the number apple acres in production in the United States; and fourth by number of apple farms (**Table 4**). Farm numbers, and their distribution by size for NY, MI, PA, and WA, along with U.S. totals, are displayed in **Table 4**. The four states encompass 29% of all apple farms. Similar patterns of farm number declines over time are evident in all states (**Figure 5**). The decline in farm numbers was the least severe in NYS from 1997 to 2012 (about 12%), relative to the three competitor states. Comparably, Pennsylvania's and Michigan's declines were 29% and 31%, respectively, while Washington showed the larges relative decline at over 42%. The decline in farms for the entire United States was 26%.

Table 4. Distribution of farms by size for select apple producing states, 2012.										
Farm size (acres)	**New York**		**Pennsylvania**		**Michigan**		**Washington**		**United States**	
	No.	%	No.	%	No.	%	No.	%	No.	%
0.1 to 0.9	267	19.6	455	29.5	297	18.8	714	25.1	10,144	40.4
1.0 to 4.9	439	32.2	642	41.8	497	31.4	522	18.4	8,486	33.8
5.0 to 14.9	250	18.3	242	15.7	313	19.8	447	15.7	3,140	12.5
15.0 to 24.9	93	6.8	52	3.4	121	7.6	216	7.6	922	3.7
25.0 to 49.9	95	6.2	64	4.2	136	8.6	362	12.8	990	3.9
50.0 to 99.9	88	6.4	40	2.6	102	6.4	247	8.7	673	2.7
100 acres or more	133	9.7	44	2.9	118	7.4	331	11.7	774	3.1
100.0 to 249.9	84	6.2	29	1.9	93	5.9	201	7.1	513	2.0
250.0 to 499.9	36	2.6	7	0.5	16	1.0	63	2.2	154	0.6
500.0 to 749.9	11	0.8	7	0.5	6	0.4	33	1.2	61	0.2
750.0 to 999.9	1	0.1	0	0.0	3	0.2	14	0.5	20	0.1
1,000 or more	1	0.1	1	0.1	0	0.0	20	0.7	26	0.1
TOTAL FARMS	**1,365**		**1,542**		**1,584**		**2,839**		**25,129**	
Source: USDA (2017d)										

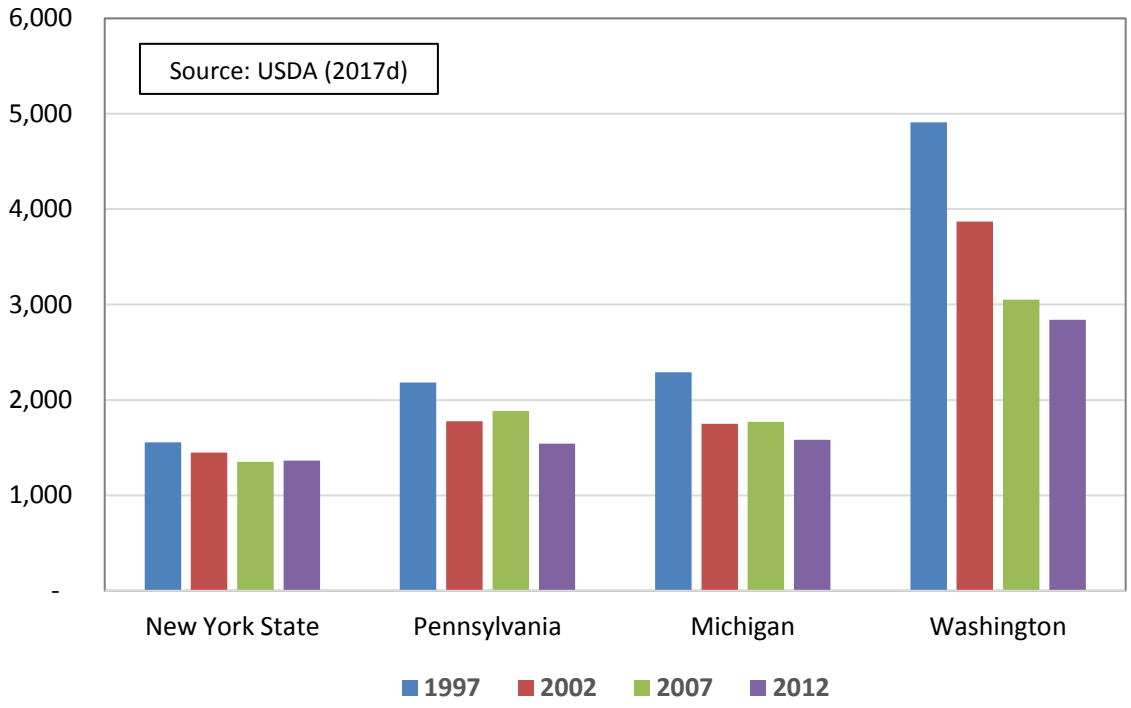

Figure 5: Number of farms with apple orchards, by state and census year.

Given farm consolidation in the apple industry, one would expect that apple acreage changes over time, *ceterus paribus*, to be more muted than changes in the number of apple farms. However, since 1997, this is true only for Washington, as all other states, including New York, have apple acreage reductions (**Table 5)** that exceed the change in number of apple farms (**Figure 5**). Accordingly, for these states, the amount of apple farm (and acreage) consolidation is insufficient to cover the loss of acreage due to conversion from apples to other crops. That being said, reductions in apple acres were lowest for NYS relative to both Pennsylvania and Michigan. Notably, these four states account for over 74% percent of all apple acres in the United States, up from total apple acres in 2012, increasing from 64% in 1997. New York's share has increased modestly, from 11% to 12%, over this same time period.

Table 5. Total acres in apples (bearing and non-bearing), by state and census year.

	Census Year				Percentage Change	
State	**2012**	**2007**	**2002**	**1997**	**Since 1997**	**Since 2002**
New York	47,148	49,966	53,233	66,055	-28.6	-11.4
Pennsylvania	21,556	23,552	28,110	36,775	-41.4	-22.3
Michigan	43,240	44,189	50,539	73,251	-41.0	-14.4
Washington	174,152	165,215	172,810	215,463	-19.2	+0.8
United States	384,237	398,770	464,025	608,462	-36.9	-17.2

Source: USDA (2017d)

As of 2012, the percentage of non-bearing acres were relatively similar across states; specifically, 13.0%, 12.6%, 13.1%, and 10.3% for New York, Pennsylvania, Michigan, and Washington, respectively (USDA 2017d). Non-bearing acres primarily include acres that are planted but have not yet come into production (i.e., immature plantings).[4] One indicator of producers' confidence in the industry is the percentage of these immature plantings. On average, the proportion of non-bearing acres increased for all states since 2007 and, on average, rose from 9.7% in 2007 to 12.3% in 2012 for all apple acres in the United States. The average for all countries in 2016 was slightly above 10%, the minimum considered necessary for sustainable production (O'Rourke 2016).

While total apple acres are decreasing, new production practices such as tall spindle systems come into production earlier, with higher yields compared to vertical axe or central leader systems. As a result, advancements in production practices have supported a trend of increased production through time (barring complications from weather events). Given the state's relatively large share of total production, U.S. production generally mirrors what is happening Washington State, although not in every year. As noted previously, the upper Midwest and Northeast were plagued by warm temperatures in March followed by a severe cold snap in April, decimating much of the crop in 2012. The nationwide harvest was down, in spite of the increase in pounds harvested in Washington. Pennsylvania, with the lowest annual production on average, has also experienced the least variation in production over time.

APPLE CROP UTILIZATION AND PRICES

NYS apple production utilized between 2000 and 2016 ranged from 630 million pounds in 2002 to 1,390 million pounds in 2013 (**Table 6**).[5] Cold weather shocks in 2002 and 2012 compromised yields, with yields returning to more normal levels in the succeeding crop years. On average, roughly one-half of the crop is utilized for fresh markets, the balance processed usage. However, there appears to exist a modest shift to fresh markets in recent years. Average prices were lowest in 2000 and highest in 2012, the latter in

[4] Technically, nonbearing acres include bearing but unpicked acres, a small proportion of the total.

[5] Approximately 10 million pounds go unutilized in NYS in any given year (USDA 2017c).

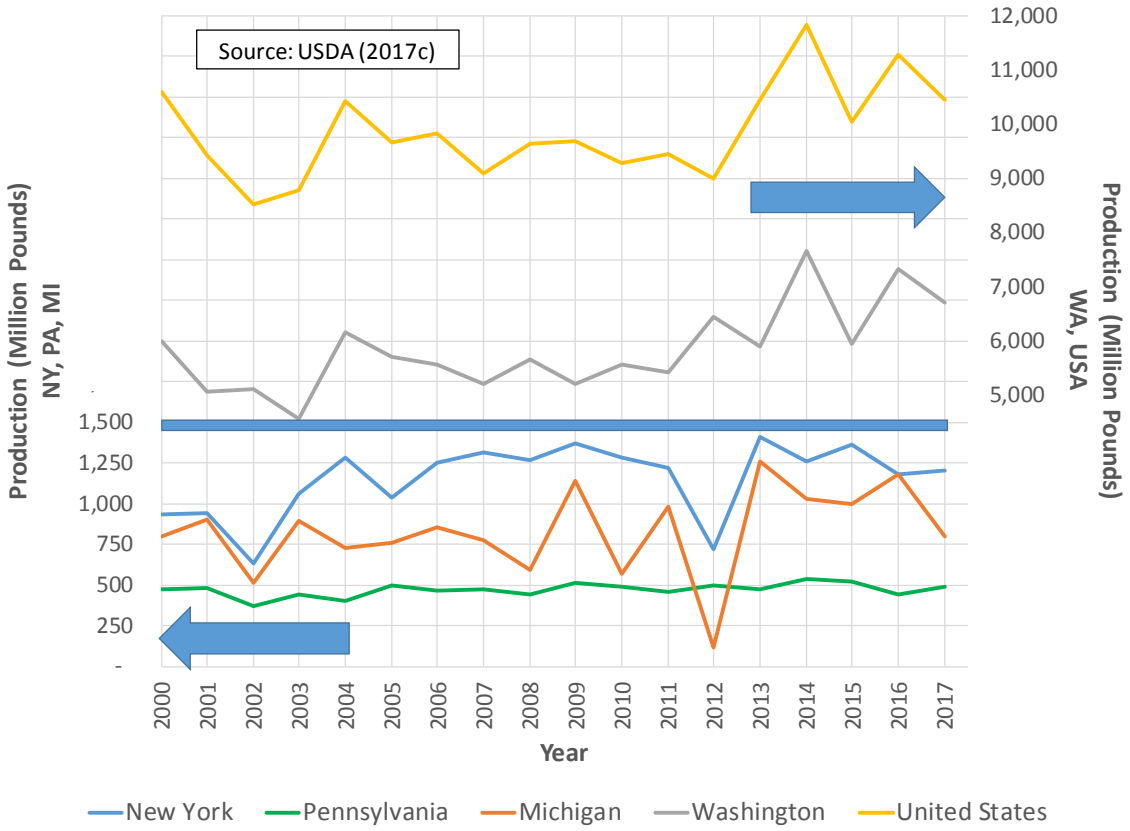

Figure 6: Total apple production by year and state, 2000 – 2015.

Table 6. Crop production utilization and prices, 2000 – 2016 marketing years, New York.

	Utilized Production (Million Pounds)			Average Price (cents per pound)		
Year	All	Fresh	% Fresh	All	Fresh	Processed
2000	935	460	49.2%	11.7	17.0	6.5
2001	940	420	44.7%	11.9	18.4	6.7
2002	630	310	49.2%	17.7	28.0	7.7
2003	1,060	510	48.1%	14.5	23.0	6.7
2004	1,280	660	51.6%	15.1	22.8	7.0
2005	1,035	490	47.3%	16.2	26.4	7.1
2006	1,250	690	55.3%	20.1	30.2	7.6
2007	1,300	690	53.1%	22.2	34.1	8.7
2008	1,240	550	44.4%	21.0	31.2	13.0
2009	1,360	685	50.4%	15.4	22.5	8.4
2010	1,270	560	44.1%	17.5	26.3	10.5
2011	1,210	530	43.8%	20.2	33.3	10.0
2012	710	335	47.2%	35.2	53.9	18.5
2013	1,390	650	46.8%	17.1	25.5	9.7
2014	1,250	625	50.0%	20.0	30.6	9.4
2015	1,350	715	53.0%	20.7	30.0	10.3
2016	1,170	650	55.6%	27.1	39.6	11.5

Source: USDA (2017c)

response to extremely short crops in NY and MI. As expected, fresh and processed market prices follow a similar pattern over time. Fresh market apples command a price premium compared to those used for processing. Fresh market prices were, on average, 3.1 three times that of processed prices, but have varied from 2.4 (2008) to 4.0 (2006), predicated on relative demands and supplies for alternative uses.

More detail on apple crop utilization, by volume and revenue, follow in **Figure 7** and **Figure 8**, respectively. For NYS, processed apples are relatively evenly distributed for canned (e.g., applesauce, pie filling) and juice products, whereas MI and PA allocations are more heavily weighted towards canned products. As expected, WA primarily focuses on fresh markets.[6] Dollar value estimates are limited to fresh and processed (total) categories in the data (**Figure 8**), and reinforce the price differences from **Table 6**.

The NYS apple industry is impacted by the global market place; indeed, local industries are impacted by global supplies, trade agreements, currency rate fluctuations, and more. Global supplies of apple juice concentrate rose dramatically from the mid-1990s to early 2000s, largely due to increased production from China. Apple juice concentrate is a storable commodity and changes in inventories can have significant influences on price. Changes in global yields will affect the quantity of apples diverted to concentrate. Between 2000 and 2008 the global production of apple juice concentrate increased 6% annually, while the global price fell around 31% (O'Rourke 2016). Growing supplies are putting downward pressure on apples for processing; however, price effects vary depending on ultimate use. Notably, juice prices in 2012 for NYS did not see a comparable price jump, even with the short crop. Availability of apple juice concentrate from other sources likely contributed to this muted effect (**Figure 9**).

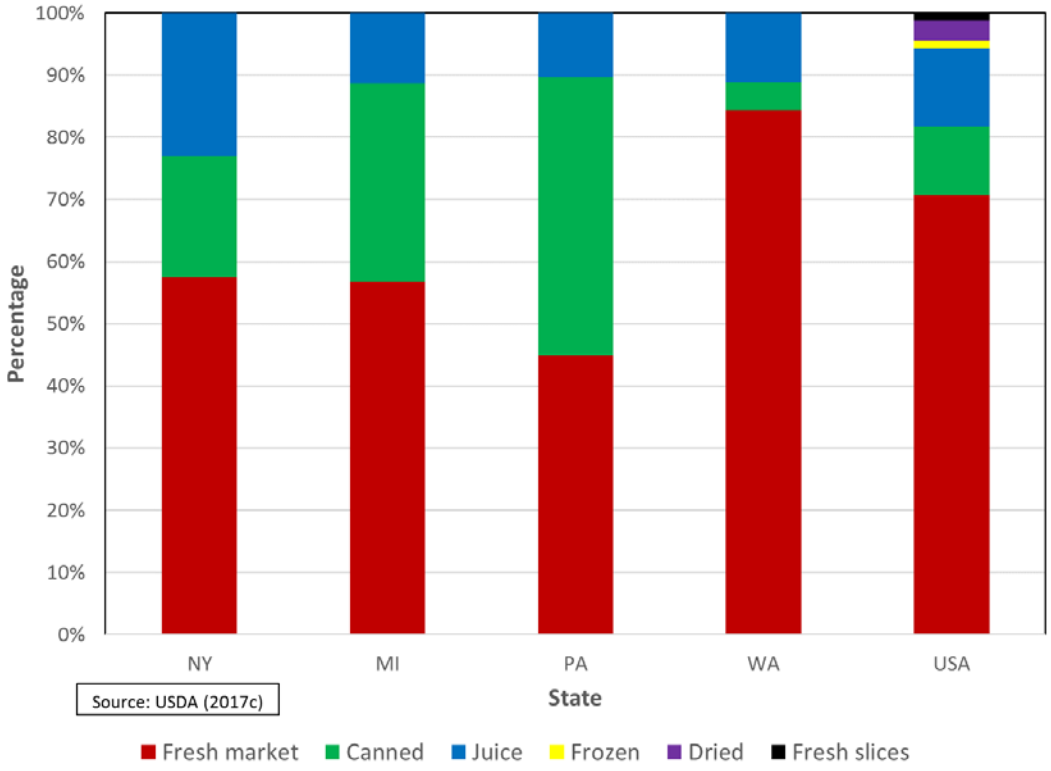

Figure 7: Apple crop utilization (volume), by type and state, 2016.

[6] State-level utilization data for processed apples is limited to canned and juice categories. National-level data also includes frozen, dried, and fresh slices, likely included in the canned category for state level estimates.

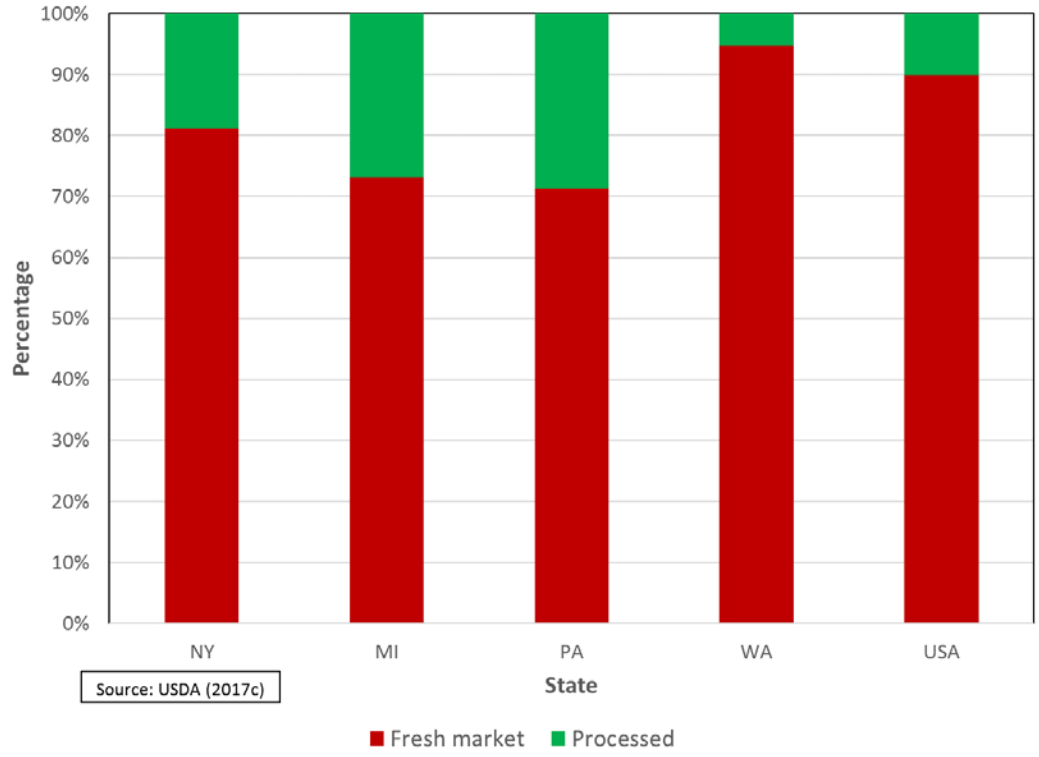

Figure 8: Apple crop utilization (dollars), by type and state, 2016.

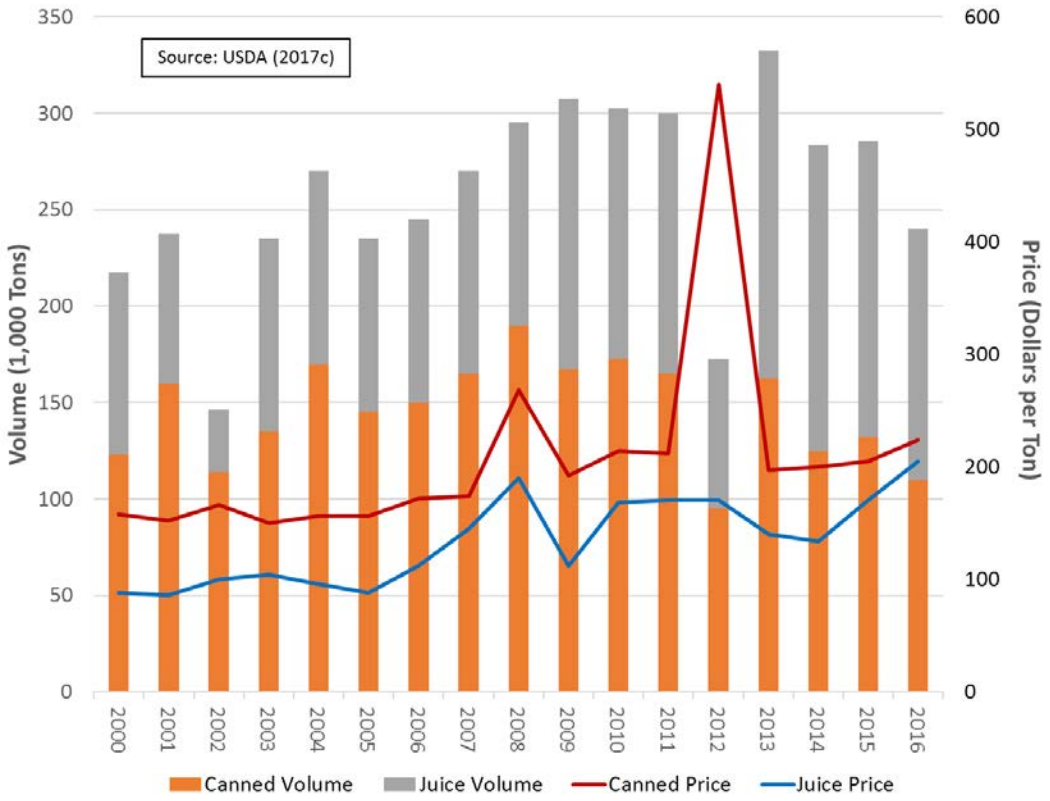

Figure 9: Volume and prices for canned and juice apple products, New York, 2000-2016.

That said, the average price difference between canned and juice products was $70/ton in 2000; in 2016, it was only $19. Increasing demands for apples for juice, along with more recent decreases in concentrate inventories are likely contributing to this change. Detailed utilization and marketing year average prices for NYS are included in **Appendix C**.

Apple processing is critical to the success of the industry. Necessarily, NYS apple processors import apples from outside of the state to maintain year-round capacity utilization and buyer demands. On average, around 5% to 10% of all processing are apples sourced from outside of the state (USDA 2017b). Most farms have a mix of varieties for fresh and processing. Some apples for processing reflect fresh maket apples that do not meet minimum standards; e.g., sort-outs from packing lines. Peelers command higher quality and price compared to those apples used for juice or cider. Apples that fail to color properly or suffer from surface blemishes; e.g. apple scab, bitter pit, sunburn or hail damage can be successfully used for applesauce and pie filling. Some juices will be processed as apple juice concentrate and subsequently used as a natural food ingredient. Apple fiber is a co-product made from apple pomace that can be incorporated as an ingredient in prepared foods to increase fiber content or as a substitute for modified food starches.

INDUSTRY STRUCTURE

The apple industry represents a complex intersection of production inputs at the farm level resulting in a crop harvested and subsequently marketed to a series of intermediaries, such as processors, wholesalers, and retailers who provide product for their respective customers, or to consumers directly through a variety of local markets (e.g., farmers markets, roadside stands, CSAa). Farm inputs (chemicals, fertilizer, labor, machinery, etc.) are utilized to produce the apples. The apples may be stored and packed at the farm or may be transported to a wholesaler for storage, packing, or processing. Fresh market apples will then be sold to retail outlets located in and/or outside of the state. Some fresh market apples and farm processed apple products will be sold directly to consumers through direct channels.

The 2014-15 *New York Apple Shipper*, *Wholesale Cider,* & *Fresh Fruit Directories* list 28 farms, distributors, and cold storage facilities with the ability to ship apples for export or gift cartons. The 2015 *New York State Processing Apple Buyer Directory* lists 6 businesses that purchase processing apples. Processors provide a variety of services, including freezing or drying, slices, branded or private label apple sauce, juice and cider, shelf stable juice, apple cider blends, apple fiber, pulp, and pomace. Four businesses are listed as apple processors and dealers. These businesses purchase apples for both in-state processors, such as Birds Eye Foods, as well as processing apples for companies located out-of-state, including PA and MI.

Hard cider and distilled spirits is receiving increased attention in the press. The directory lists 16 businesses that provide fresh or hard cider, flavored ciders, organic, or certified kosher cider. Hard cider sales has been a fast growing beverage category over the past 10 years. However, sales are slowing and industry growth in 2015 was less than in 2014 (Colby 2016). This trend is largely based on changes in large-scale commercial cider production. Counter to this large-scale trend is the emergence of craft cideries and distilleries. Before the NYS *Farm Cideries Law* went into effect (2014), hard cider could only be produced at farm wineries or by processors with a cider producer license. The *Farm Cideries Law* was modeled from similar provisions for farm breweries, wineries, and distilleries. The legislation allows cideries to sell farm-produced cider by the glass or bottle, operate a gift shop, and open a restaurant. The NYS Liquor Authority listed 24 licensed farm cideries in 2014. Some orchardists with on-farm cideries are investigating and planting new and heirloom apple varieties to improve product quality Other cidery operators are interested in purchasing unique apple varieties from apple farmers. The New York Cider Map and Directory lists 76 cideries within the state (West 2017).

APPLE MANUFACTURING TRENDS NEW YORK STATE

The strength of an economic sector can be examined through the number of firms, trends in employment, wages, investment, and indusry production. The U.S. Census Bureau provides industry data through their Economic Census (every 5 years), as well as through annual surveys vis a vis County Business Patterns and Nonemployer Statistics, among others.. Following the North American Industry Classification System (NAICS), we particularly examine industry sector 311421, fruit and vegetable canning.[7] Issues with this particular categorization will resurface in the economic contribution analysis below, include combining both fruits and vegetable processing, and no further deliniation to apples. Much of this makes sense from an industry perspective, where processors may utilize a number of fruits and/or vegetables as processing inputs. For the purposes here, we anticipate the trends and statistics coming from this sector will generally represent issues within apple processing more specifically.

The levels of establishments, business volume, and employment in NYS over the last three census years are included in **Table 7**. While the number of nonemployers far exceeds employer firms, they are primarily quite small and contribute less than 0.5% of total industry production. However, successful nonemployee startups will lilkely hire employees in the future, and establishment numbers are growing. In addition, note the strong growth from 2012 to 2015, indicative of an an uptick in entrepreneurial ventures in this industry. The predominance of industry output is with employers,where in 2012 (last census year) total fruit and vegetable canning exceeded $1.7 billion. On average, employers are relatively large, in excess of 80 workers through 2012, with nearly one-half of all firms having more than 20 employees. However, total output decreased from 2007 to 2012 (in nominal terms), as did total employment by about 500 workers. Interestingly, the latest statistics via County Business Patterns (CBP) indicate strong growth in establishment numbers, likely relatively small, as the average employees per establishment and establishments with more than 20 employees decreased substantially (USDA 2016b).[8]

Table 7. Economic activity, fruit and vegetable canning, selected years, New York.[1]

Variable	2002	2007	2012	2015
Nonemployer Establishments (3114)				
Establishments (No.)	na	195	271	316
Total receipts ($000)	na	7,108	6,778	10,384
Receipts per establishment ($)	na	36,451	25,011	32,861
Employer Establishments (311421)				
Establishments (No.)	49	44	41	64
Total receipts ($000)	1,851,579	2,018,703	1,703,028	
Receipts per establishment ($000)	37,787	44,860	39,605	
Total employees (No.)	3,746	3,994	3,492	3,329
Employees per establishment	76	89	81	52
Establishments with more than 20 employees (%)	47	53	47	34

Source: U.S. Census Bureau (2014a, 2016a, 2016b).

[1] Nonemployer establishments are firms without paid employees (i.e., payroll). na = not available.

[7] NAICS 311421 is a sub-industry of NAICS 3114. The aggregate industry includes establishments that freeze food and those that use preservation processes, such as pickling, canning, and dehydrating, while NAICS 311421 is limited to establishments primarily engaged in manufacturing canned, pickled, and brined fruits and vegetables. This industry is particularly applicable to apple processing as it includes both juices and other canned products (e.g., jellies, pie filling, sauces), the predominant processed apple products in NYS. Note, however, that *Nonemployer Statistics* include data to only the 4-digit level by state. For these statistics, we follow NAICS 3114.

[8] Total receipts are not reported in the annual, between census years data with *County Business Patterns*.

A more detailed composition of economic activity is included in **Table 8** for employer establishments (311421), in nominal as well as real terms (2012 dollars).[9] The data spans 10 years and includes the 2008 economic recession. Based on differences between the 2002 and 2012 statistics, it appears that the industry has not returned to pre-recession levels. Data for years 2002 and 2007 shows the sector to be mostly stable to slightly increasing in terms of number of employees, payroll, value of shipments, and capital investments. Between 2007 and 2012, all of these variables decreased.

In real terms, total payroll has decreased, consistent with decreases in employees. However, wages per worker have decreased as well, which may indicate a shift in hiring patterns or job displacement through technology adjustments. Part of the decrease is also attributed to a decrease in number of total production worker hours. Given that some production workers are seasonal, the sharp drop in farm output in 2012 likely contributes to this trend. In real terms, total receipts declined at an annual average rate of 7%. Since the costs of materials are relatively constant over time, demand side influences on market prices and global supply variation are primarily of consequence. Notably, real capital investments were roughly one-half of 2002 levels by 2012.

Overall the fruit and vegetable canning sector in NYS continued to consolidate between 2002 and 2012 as the number of establishments declined, along with the number of employees (**Table 9**). Companies may streamline corporate management and contract for services as a way to cut payroll costs, especially overhead during economic downturns. In real terms, total payroll has not returned to 2002 levels and annual payroll per employee has declined. This is not necessarily sector specific as wages of lower salaried employees and hourly workers have stagnated throughout the United States. That said, real dollar declines in industry receipts and capital investments is difficult to ignore.

Clear differences exist across NY's 3 competitor states (MI, PA, and WA), some in NY's favor, others not. Evaluating this same ten-year time period, Michigan's fruit and vegetable canning sector was clearly growing. Establishments were up, as were employees and employee wages (**Table 9**). In real terms, industry receipts were up over 50%, however material costs more than doubled over this time period. Accordingly, there was a reduction in total added value (i.e., primarily payments to employees and owners). With rising payrolls (+58%), allocations to owners (proprieters and corporations) were down over 20%.[10] Negative contributions to value added is not long-term sustainable, but may make economic sense in a period of rapid expansion. Industry data for Pennsylvania was limited, but for all indicators available (i.e., establishments and employees) contraction was evident, and more so than witnessed in New York.

Strong industry contraction was also evident for Washington over this time period, where both establishment numbers and the number of employees had strong reductions, greater than those experienced in NYS. As with NYS, some savings in real materials costs were realized in Washington, but were insufficient to offset larger reductions in total industry receipts. When reductions in payroll are deducted from added value, the implied reduction in payments to owners was 40% over this time period. Only New York's reduction of 55% was larger.

[9] All monetary values were converted to 2012 dollars using the Consumer Price Index, Northeastern U.S., All Urban Consumers (BLS 2017).

[10] Payments to owners (proprietors and/or corporations) are referred to as "Added value less payroll" in Table 9. It is computed as "Added value" minus "Payroll". While value added also includes payments to government (i.e., taxes on production and imports), our definition of payments to owners is inclusive of government payments.

Table 8. Selected economic indicators for the fruit and vegetable canning, employers only, New York.						
	Nominal dollars			Real dollars (2012 = 100)		
Variable	2002	2007	2012	2002	2007	2012
Establishments (No.)	49	45	43	49	45	43
Employees (No.)	3,746	3,994	3,492	3,746	3,994	3,492
Payroll ($1,000)	128,988	158,909	139,026	168,397	177,070	139,026
Payroll per establishment ($1,000)	2,632	3,531	3,233	3,437	3,935	3,233
Payroll per employee ($)	34,434	39,787	39,813	44,954	44,334	39,813
Production workers (No.)	2,769	3,333	2,537	2,769	3,333	2,537
Production worker wages ($1,000)	80,730	121,542	98,153	105,395	135,433	98,153
Wages per production worker ($)	29,155	36,466	38,689	38,063	40,634	38,689
Added value ($1,000)	977,240	1,119,396	641,251	1,275,812	1,247,327	641,251
Added value less payroll ($1,000)	848,252	960,487	502,225	1,107,415	1,070,257	502,225
Cost of materials ($1,000)	874,778	899,420	1,061,777	1,142,045	1,002,211	1,061,777
Total receipts ($1,000)[1]	1,851,579	2,018,703	1,703,028	2,417,285	2,249,412	1,703,028
Receipts per establishment ($1,000)	37,787	44,860	39,605	49,332	49,987	39,605
Capital expenditures ($1,000)	45,692	37,520	31,940	59,652	41,808	31,940
Capital expend. per establishment ($1,000)	932	834	743	1,217	929	743

Source: U.S. Census Bureau (2014).

[1] Disclosure issues prevented total receipts for 2012 from being reported. Added value + cost of materials is a very close approximation.

In a review of the food processing industry in Washington in 2008, it was noted that new competitors from Asia, Australia, New Zealand, and Europe were competing effectively for U.S. markets and for traditional export markets of Japan and Canada (WSDA 2008). Increased transportation costs had reduced industry competitiveness and historical competitive advantages in low-cost water for irrigation and in-plant processing, low-cost hydroelectric power, and low-cost land had eroded compared to the competition in other countries. Many processing facilities were over 20 years old and outdated, while mass production of commodity-style, undifferentiated products fell out of favor as consumer preferences for value-added, unique, and just-in-time products increased (WSDA 2008). With acres in production declining, Washington found itself with an over-supply of processing capacity (WSDA 2008). These primary determinants of industry growth and resiliency; i.e., input cost competitiveness, research and new product development, and plant capacity and investment, are equally relevant in New York State

Table 9. Percentage changes in economic indicators (2012 dollars) for the fruit and vegetable canning, 2012 relative to 2002, by state.

Variable	NY	MI	PA	WA
Establishments	-12.2	+17.2	-25.0	-9.7
Employees	-6.8	+50.1	-6.6	-28.9
Payroll	-17.4	+58.2	na	-16.2
Payroll per establishment	-5.9	+34.9	na	-7.2
Payroll per employee	-11.4	+5.4	na	+18.0
Production workers	-8.4	+52.6	-9.3	-31.2
Production worker wages	-6.9	+64.3	na	-23.1
Wages per production worker	+1.6	+7.7	na	+11.9
Added value	-49.7	-4.4	na	-33.6
Added value less payroll	-54.6	-20.5	na	-40.0
Cost of materials	-7.0	+117.7	na	-15.9
Total receipts	-29.5	+54.4	na	-22.5
Receipts per establishment	-19.7	+31.7	na	-14.1
Capital expenditures	-46.4	na	+67.8	na
Capital expenditures per establishment	-39.0	na	+123.8	na

Source: U.S. Census Bureau (2014.)

METHODOLOGICAL FRAMEWORK

Input-output (IO) models provide an insightful way to depict and investigate the underlying processes that bind an economy together. Its strengths lie in a detailed representation of the primary and intermediate input requirements by production sector, the distribution of sales of individual industries throughout an economy, and the interrelationships among these industries and other economic sectors of an economy. The methodology's analytical capacity lies in its ability to estimate the *indirect* and *induced* economic effects stemming from the *direc*t expenditures that lead to additional purchases by users in an economy (Schmit and Boisvert 2014). Our description of these effects for the apple industry in NYS include four common economic measurements - output, labor income, total value added, and employment (**Box 1**).

The indirect and induced changes in economic activity result from what are commonly known as *multiplier* effects throughout the various sectors in the economy. Indeed, it is the cumulative impacts across all affected industries that are of most interest (direct + indirect + induced). The indirect impacts could be in the form of additional purchases of a variety of goods and services or in the form of the increased labor income generated due to the increased economic activity. To the extent that the additional income is spent within the defined local economy, additional effects are created, commonly referred to as induced impacts. Magnitudes of the indirect and induced effects will differ by industry sector.[11]

Box 1. Metrics Considered in the Analysis	
Output	The value of industry production in producer prices; for manufacturers = sales + changes in inventory, for service sectors = sales, for retail & wholesale sectors = gross margin.
Labor Income	All employment income; employee compensation (total payroll cost) + proprietor income (self-employed + unincorporated business owners).
Value Added	Gross regional product derived from income paid to owners of the factors of production. Output - cost of intermediate inputs. Includes labor income, other property type income, and taxes.
Employment	The average annual number of jobs, both full and part time. Not full-time equivalents.
Source: IMPLAN (2016)	

Using the IMPLAN databases, it is possible to examine transactions among 536 industrial sectors of an economy as defined by the North American Industry Classification System (NAICS), the standard used by Federal statistical agencies to classify business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. The customized NYS model developed for the apple industry supply chain represents a fully disaggregated 536 industry model.[12] When presenting the results, however, the empirical results are aggregated to the 2-digit NAICS level (excluding the apple industry sectors) for ease of exposition.

CONTRIBUTION ANALYSIS

One approach to assessing an industry's effects is through an economic contribution analysis. In deference to an *impact* analysis that considers marginal changes in deliveries to final demand induced by a policy or private policy/initiative, a *contribution* analysis for an industry (or collection of industries) describes that

[11] For a more detailed discussion of input-output analysis used within the context of this report, see Schmit and Boisvert (2014). For a comprehensive application of input-output methods and theory, see Miller and Blair (2009).

[12] Technically, we develop a Social Accounting Matrix (SAM) model within IMPLAN, rather than an IO model. The SAM has an input-output model at its core, but because the SAM distinguishes household purchasing patterns by income group, the impacts and multipliers based on the SAM reflect the multipliers throughout the economy with somewhat greater precision than do those based on an IO model (Miller and Blair, 2009, chapter 11).

portion of an economy that can be attributed to the existing industry (or industries) by using data internal to the underlying input-output (IO) model to identify all backward linkages in the study area.[13] In a contribution analysis, existing total output, not just final demand, provides the initial (direct) effects of the analysis and, when compared to the entire economy, the results provide insight into the relative extent of the industry in the economy and the strength of its backward linkages. In our particular application, IO analysis is used to assess how the value of apple industry supply chain (apple production, support services, manufacturing, marketing, and research) permeate throughout the state's economy. In addition to presenting the total economic effects over the four metrics described above (Box 1), we also describe the distribution of indirect and induced effects.

The contribution analysis conducted here follows the methodological framework outlined in Schmit (2016). Following IMPLAN's recommended procedures for a multi-industry economic contribution analysis, two preliminary model customization steps are required before estimating the indirect and induced effects.[14] First, commodity production for each apple supply chain industry is modified so that each industry produces only its primary commodity; i.e., no by-products. This is necessary since trade flows within IMPLAN apply to commodities, not industries. In other words, commodities are traded (not industries), and industries may produce more than one commodity.[15] Second, within the trade flows data, the Regional Supply Coefficient (RSC) for each commodity contained in the contribution analysis is set to zero. The RSC indicates the proportion of the local supply of a commodity that goes to meet local demands. Changing the RSC implies that all specified industry sectors will have sales only to export markets (domestic or foreign), with zero intermediate output. This ensures that no one will purchase from these industries beyond the industry's total output. It forces the model to not be able to create any additional local impact for any of the sectors included in the contribution analysis, and effectively eliminates double counting of backward linkages.

Since all "intermediate" sales have been changed to "final" sales in this approach, the direct and indirect effects reported in a contribution analysis have slightly different interpretations than those for traditional 'impacts'. Specifically, the direct effects (with respect to output) represent all sales by the industries of interest (in our case, apple supply chain industries). Total gross output is used as the direct effect, including final demand and the indirect and induced effects associated with that final demand. The indirect effects represent all sales by the backward-linked supply chain industries. In other words, all indirect purchases in upstream sectors outside of the apple supply chain industries considered in the direct effect. The induced effects (by households) have their common interpretation; i.e., additional industry sales due to consumption out of labor income.

One additional model customization was necessary for a NYS-specific apple industry analysis, and was conducted prior to the commodity production and trade flows adjustments outlined above. Importantly, we allow for (and collect primary data on) geographic- and commodity-specific industry conditions for NYS. Within the IMPLAN industry scheme, apple farming is included within a more aggregate "fruit

[13] Final demand is defined as the value of goods and services produced and sold to final users (institutions) during the calendar year. Final use means that the good or service will be consumed and not incorporated into another product (IMPLAN 2016).

[14] For details go to http://support.implan.com/index.php?option=com_content&view=article&id=366.

[15] Most industries produce one primary commodity and a small amount of by-products, or secondary commodities. These are defined for each industry within IMPLAN based on the Bureau of Economic Analysis, U.S. Department of Commerce, National Income and Product Accounts. For example, the fruit farming industry (where apple farming resides), produces primarily "fruit" (98.3% of all output), plus a small amount of "support activities for agriculture;" e.g., crop spraying by farms (1.1%), and "other amusement and recreation;" e.g., agri-tourism (0.6%).

farming" industry. For NYS, other fruit primarily consists of grape farming (mostly Concord and Niagara grape production), but also some cherry and stone fruit production. Rather than using the default IMPLAN production function coefficients (i.e., spending on intermediate inputs and outlays to value added), it is important to update coefficients when local area data are available. In general, gross spending patterns for industries within IMPLAN (i.e., ignoring local versus nonlocal purchases) are indifferent across geographies, including states. Accordingly, a fruit farm in Washington would have an identical spending pattern to produce its output as a fruit farm in NYS. Given differences in climate, soils, crop varieties, and production practices this is likely a poor assumption. Aggregation issues become even more problematic when multiple commodity fruits are represented within one industry, rather than apple farming alone. For example, is a grape farming production function similar to that for apples? Likely not.

To account for these issues explicitly, we utilize a combination of data from an online financial survey of NYS apple producers and from the latest *Fruit Farm Business Summary* (Lake Ontario Fruit Team 2017) to estimate a NYS-specific apple farming production function.[16] The procedure importantly accounts for actual spending by apple farms in NYS and, thus, leads to more accurate industry contribution estimates The detailed NYS apple farming production function is included in **Appendix E**

This level of customization must also consider sales by apple farms and the particular industries (e.g., processors) and institutions (e.g., households) that they sell to. In so doing, we assume that all sectors purchasing fruit, now purchase a combination of apple and non-apple fruit, based on the relative industry sales patterns for the aggregate fruit farming industry in IMPLAN. In so doing, each industry's production function is adjusted to reflect purchases of both apple and non-apple fruit commodities. Institutional purchases are similarly disaggregated. Finally, commodity balances and trade flows across commodities must be adjusted to reflect disaggregation of the fruit farming sector and accounting for all commodity flows within the local economy, imports, and exports (foreign and domestic). We follow the procedure advocated by Schmit and Jablonski (2017) for creating a new sector in IMPLAN.[17]

APPLE INDUSTRY SUPPLY CHAIN SECTORS

Seven distinct, yet linked, apple supply chain sectors were defined for this study, representing key apple industries from support services, to production, to processing (**Figure 10**). For apple farming, nursery stock and support service industries represent input sectors, while processor and fresh sales represent output sectors. Accordingly, input services to farming are represented within their production function (input expenditures), while sales sectors (including households) are represented in the total value of farm output. Since the output for support service and nursery stock sectors (i.e., sales) are represented as input costs within farming, it is important not to double count these activities when doing a multi-industry contribution analysis, as well as to account for any intra-industry farm sales to and from each other. A similar example can be constructed between farming and the downstream processing sectors. The methodological procedures outlined above account for these issues. The total output and employment (direct effects) for each industry are shown in **Table 10**.

[16] A copy of the apple farm and intermediary surveys are included in **Appendix C** and **Appendix D**, respectively. The survey was administered online (via Qualtrics) and available in a hard-copy, mail in format. We are grateful to the New York Apple Association in promotional efforts and in helping administer the survey to their members. Limited response rates from intermediaries precluded their use in modifying IMPLAN data. The Fruit Farm Business Summary data were provided by the Lake Ontario Fruit Team of Cornell Cooperative Extension for the 2015 crop year.

[17] The procedure requires using an existing nonproduction (zero output) sector in IMPLAN as the placeholder for apple farming. In our case, we utilize IMPLAN industry "tobacco farming", industry code 7, as no tobacco farming exists in NYS.

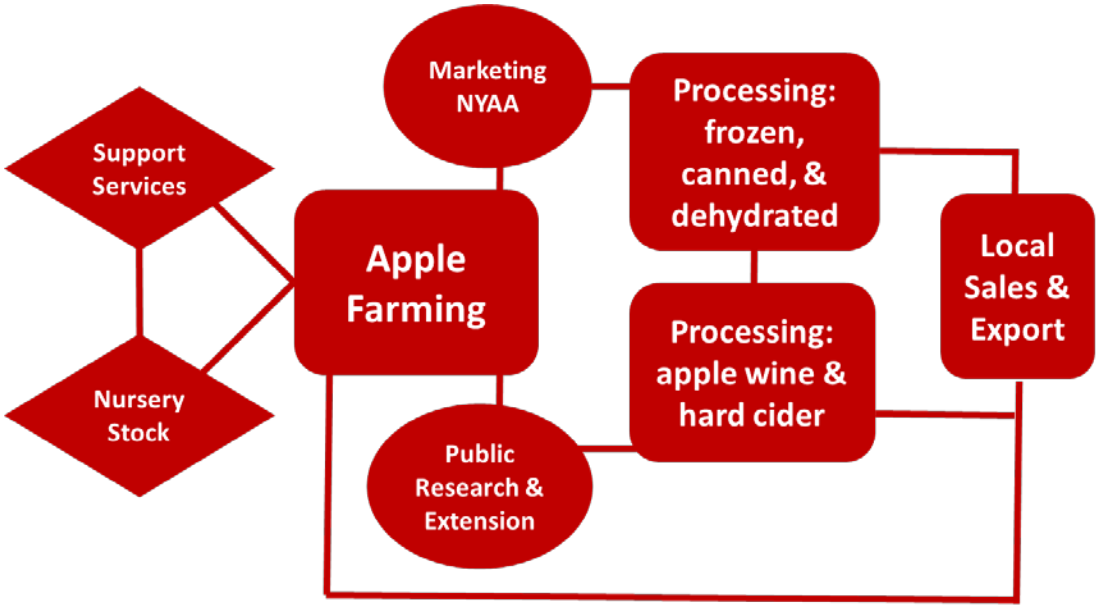

Figure 10. Conceptual representation of the apple industry supply chain.

Table 10. Direct effects for apple industry supply chain, New York, 2016 dollars.

Industry Code(s)	Description	Employment (jobs)	Output ($ Million)
19	Agricultural support services	265	11.9
6	Fruit and nursery stock	81	7.1
7	Farm production	5,605	317.0
79, 81, 83	Processing: frozen, canned, & dehydrated	1,635	838.8
109	Processing: apple wine and hard cider	425	129.8
457	New York Apple Association (marketing)	6	3.1
456	Public research & extension (Cornell)	16	2.2
	Total	**8,033**	**1,309.9**

Source: Apple farm survey, IMPLAN (2016), Lake Ontario Fruit Team (2017)

Agricultural support services: Support activities for apple production are accounted for within the IMPLAN industry "support activities for agriculture and forestry," industry code 19. For the apple industry, this would include field, scouting, packing, grading, storage, and related services provided by firms. Any of these services conducted within farm operations (rather than contracted for) would be included within the farm production function through other activities such as labor, maintenance and repair, utilities, etc. To estimate the direct effect of firms involved in these business activities, we take a share of the aggregate support services sector (19), based on apple farming output relative to total agriculture farming output in NYS. Employment follows based on the aggregate sector ratio of jobs per dollar of output. The IMPLAN production function (intermediate input purchases and value added outlays per dollar of output) and local purchase percentages for industry 19 were utilized in the contribution analysis.

Fruit and nursery stock: Firm activities associated with these operations are included in IMPLAN's "greenhouse, nursery, and floriculture" sector, code 6. There are very few commercial tree fruit nurseries in NYS (e.g., Wafler Nursery and Cummins Nursery). Recommendations from the Lake Ontario Fruit Team

estimated a production of approximately one million trees per year in the state, at $7/tree for 2015. Trees produced by growers are far more common and integrated within their farm businesses. As above, these are accounted for within the apple farm production function itself through labor and input costs. The IMPLAN production function and local purchase percentages for industry 6 were utilized in the contribution analysis.

Farm Production: 2016 apple farm value of production from USDA (NASS) was used as the measure of total output. As described above, detailed financial information from the 2015 Fruit Farm Business Summary and online survey data were used to estimate an apple farm production function for this analysis (**Appendix E**), including outlays for employee compensation. The compensation estimate, along with IMPLAN's compensation per worker estimate for fruit farming were used to estimate total jobs. Local purchase percentages were not available within the Fruit Farm Business Summary data and insufficient responses precluded their use from the online farm survey. Accordingly, IMPLAN local purchase percentages for fruit farming (industry 4) were utilized in the contribution analysis

Processing – Frozen, canned, & dehydrated: Separate apple manufacturing sectors are not included within IMPLAN or NAICS sectors. Furthermore, fruits and vegetables are aggregated together, with sector delineations based on type of processing. Detailed inspection of commodities produced in IMPLAN's frozen, canned, and dehydrated fruit and vegetable processing sectors (79, 81, and 83, respectively) found considerable overlap with a number processed apple products (e.g., frozen fruit juice concentrate, juices, jellies, slices, etc.).[18] Based on IMPLAN data, fruit production sold as intermediate inputs to processors represents 66% of all fruit and vegetable production sales to these markets. Additionally, based on USDA estimates, approximately 68% of all fruit production sold for processing in NYS is apples. Accordingly, we estimate apple processing direct output (employment) in NYS to be 45% (0.66 x 0.68) of the combined industry output (employment) of IMPLAN sectors 79, 81, and 83. Cider vinegar and nonalcoholic cider manufacturing are classified within the "mayonnaise, dressing, and sauce manufacturing" industry, IMPLAN code 103. With insufficient information to pull out the apple cider components from the aggregate industry, we exclude these values from our analysis. For farms that sell nonalcoholic cider as part of their apple farm business, cider sales should be reflected in total farm output. For processors that fall under 79, 81, and 83, and also produce some cider vinegar and/or nonalcoholic cider, the value of these products sold should also be reflected in their total output. The IMPLAN production function and local purchase percentages, for industries 79, 81 and 83, were utilized in the contribution analysis.

Processing – Hard cider & apple wine: Hard (alcoholic) cider, applejack, and apple wines fall under the large "wineries" sector in IMPLAN, code 109. Retail cider prices from Nielsen CGA (Brager and Crompton 2017) were used in concert with alcohol and tobacco tax and trade bureau (TTB) cider production (volume) data (U.S. Department of the Treasury 2017) to estimate total output for this supply chain industry. Total winery employment per dollar of output from IMPLAN was used to estimate employment. Apple distillery output is included in the "distilleries" sector of IMPLAN (industry 110). While a growing industry in NYS, total output is relatively small and, ultimately, unavailable from existing sources, so is excluded from our analysis. To the degree that hard cideries are also distilling apple liquors, output should already be accounted for. The IMPLAN production function and local purchase percentages for wineries (industry 109) were utilized in the contribution analysis.

[18] IMPlAN industries 80 and 82 represented frozen and canned specialty product manufacturing, with little to no overlap with apples as inputs. As such, we do not include any of these sectors' output within the apple industry supply chain.

Marketing – New York Apple Association: 2015 income, expense, and employment estimates were provided by the NYAA. Income primarily reflects marketing order assessments received from NYS apple producers and processors and inherently included in the farm and processor production functions. General spending categories within their data precluded specific mapping to IMPLAN sectors. Alternatively, we utilize the IMPLAN production function and local purchase percentages for "advertising, public relations and related services" (industry 457) in the contribution analysis.

Public research and extension – Cornell/Cornell Cooperative Extension: The Cornell University Office for Sponsored Programs (OSP) provided the value and duration of all outside grants and contracts awarded over the previous five years related to apple research (farm, processing, or marketing). Average annual funding was computed and used as the output estimate. Notably, 19% of funding was from the Apple Research and Development Program in NYS (funded by apple producers and processors) and of the remaining awards, approximately 4% were received from other NYS sources (e.g., the NY Farm Viability Institute). Cornell Cooperative Extension (CCE) provided additional expenditure and employment data for apple research and extension activities, primarily associated with the Lake Ontario Fruit Team, the Eastern New York Commercial Horticulture Program, and Harvest New York. The OSP and CCE data were combined to come up with the total output and jobs estimates. Lacking detailed expenditure data, the IMPLAN production function and local purchase percentages for "scientific research and development services" (industry 456) were utilized in the contribution analysis. The NYS portion of funding in the OSP and CCE data, including county-level funding for CCE activities, are funded via NYS taxpayers. Accordingly, we account for the level of this tax via a negative household income change, reducing the induced effects for this industry segment.

One additional apple supply chain component deserves mention here; namely, **commercial apple storage**. While we do not include the economic value of these firms in the direct effects, they are represented within indirect effects via apple farms and processors that utilize these services (i.e., it is included in their production functions) In particular, they will be reflected as either contracted expenditures to commercial storage firms (e.g., IMPLAN industry "warehousing and storage," code 416), within farm expenditure categories associated with the costs of on-farm storage, or both. What is likely excluded are patronage refunds to farmers (i.e., distribution of net profits to members) from farmer-owned cooperative storage facilities in the state.

ECONOMIC CONTRIBUTION

The direct effects outlined above were included in a multi-industry contribution analysis within IMPLAN, importantly accounting for inter-industry linkages among the apply supply chain sectors to avoid double counting. All monetary measurements are presented in 2016 dollars. Aggregate and individual apple supply chain industry contributions are shown in Table X. Individual industry contributions allow a more detailed comparison of the relative size of contributions across industries, and their related indirect and induced effects. Individual industry estimates reflect industry linkages with both non-apple and other apple industries. In addition, the relative contributions within industries can provide insight into the input-based nature of their production processes. For ease of exposition, we leave a detailed examination of each of the sector's results to the interested reader. However, note that the relative composition of indirect and induced effects reflect, in part, differences in the labor use intensity across industries (i.e., value of intermediate input purchases versus value added outlays per dollar of output).

TOTAL ECONOMIC CONTRIBUTIONS

The economic contribution of the apple industry supply chain on total industrial sales in NYS was estimated to be $2.1 billion in 2016 (**Table 11**). The $1.3 billion of direct contributions (total gross output) support an additional $441.3 million and $314.3 million in indirect and induced industry sales, respectively, through non-apple firm industry linkages. Individual apple supply chain industry contributions (i.e., for farm production, services, processing, marketing and public research and extension) are also shown in **Table 11**. Note that while the direct contributions across industry segments are additive (i.e., for the direct effects, the seven individual values sum up to the total direct effect), the same is not true for the indirect and induced impacts. For example, when looking at the processing (frozen, canned, and dehydrated) sector in isolation, a portion of the $318.5 million in indirect output includes backward-linkages to apple farm production sector through processor purchases of local apples from apple farms. Thus, when looking at the composite industry results, those indirect effects for processors are already accounted for in the direct effects for farming. Simply summing the individual indirect and induced impacts across agriculture's three components would result in double counting.

The contribution output multiplier for the aggregate apple industry supply chain in NYS (i.e., the sum of the direct, indirect, and induced effects divided by the direct effect) is 1.58, meaning that for every dollar generated in the apple industry (broadly speaking), $0.58 is generated in backward linked (non-apple) industries (**Table 11**). Decomposing the multiplier effect into its indirect and induced components, the indirect effect is 0.34 (from business-to-business activity) and the induced effect is 0.24 (from labor income spending). Individual component contributions and multipliers vary based on the type of spending, industry linkages, and the degree that spending is local (within the state).

Total employment contributions of the apple industry supply chain in NYS are estimated at 11,872 jobs, 8,033 jobs through direct employment, and an additional 3,839 through non-apple indirect and induced industry effects (**Table 11**). As with industry output, the majority of indirect and induced jobs are generated by agricultural manufacturing activity. Indeed, the apple processing industries both have employment multipliers that exceed two, and well above apple farming (1.25). The result illustrates the strong linkages processors have to the farm sector as part of the indirect effects for processing include on-farm employment. In total, for every job generated by the apple industry, another 0.48 jobs are supported in backward-linked non-apple industry sectors. Larger induced employment effects, relative to indirect effects, is consistent with relatively higher labor-intensive industries related to household spending (e.g., healthcare, retail spending, etc.).

Now consider labor income, which includes employee compensation (wages and benefits) and proprietor (self-employment) income. The entire industry generates $317.2 million in direct labor income and expands to $587.9 million when all backward linkages are considered. The overall labor income multiplier is 1.85, which indicates that for every additional dollar of labor income generated in the apple industry, $0.85 of labor income is generated elsewhere in the NYS economy. The multiplier effect is weighted slightly more towards indirect effects ($0.49) than induced (0.37).

Finally, consider total value added, which includes labor income, but also other property type income (e.g., corporate profits, capital consumption, interest), and government taxes and fees. It is equivalent to the contributions to the state's Gross Domestic Product (GDP). Here, the apple industry contributes $397.9 million to the state's total GDP through its direct activity, and additional indirect and induced contributions of $254.6 million and $200.6 million, respectively. This implies that for every dollar of GDP contributed by the NYS apple industry, an additional $1.14 are generated in backward linked industries.

Table 11. Economic contribution of the apple industry in New York, by sector, 2016 dollars					
Category and Sector	Direct Effect[1]	Indirect Effect[2]	Induced Effect[3]	Total Effect[4]	Contribution Multiplier[5]
Output ($ million)					
Agricultural support services	11.9	1.6	5.7	19.2	1.62
Fruit and nursery stock	7.1	0.6	2.9	10.6	1.49
Farm production	317.0	116.0	141.0	574.0	1.81
Processing (frozen canned, dehydrated)	838.8	318.5	149.8	1,307.1	1.56
Hard cider and apple wine	129.8	52.9	36.2	218.9	1.69
New York Apple Association	3.1	0.8	1.2	5.2	1.65
Public R&D - Apples (Cornell, CCE)	2.2	1.1	0.3	3.6	1.65
Total	**1,309.9**	**441.3**	**314.3**	**2,065.5**	**1.58**
Employment					
Agricultural support services	265	7	36	308	1.16
Fruit and nursery stock	81	5	18	104	1.28
Farm production	5,605	525	886	7,016	1.25
Processing (frozen canned, dehydrated)	1,635	1,441	940	4,016	2.46
Hard cider and apple wine	425	252	228	905	2.13
New York Apple Association	6	5	8	19	3.19
Public R&D - Apples (Cornell, CCE)	16	6	2	24	1.49
Total	**8,033**	**1,849**	**1,989**	**11,872**	**1.48**
Labor Income ($ million)					
Agricultural support services	7.7	0.5	2.1	10.4	1.34
Fruit and nursery stock	4.0	0.2	1.1	5.3	1.33
Farm production	164.7	40.6	52.1	257.5	1.56
Processing (frozen canned, dehydrated)	106.9	113.8	55.4	276.0	2.58
Hard cider and apple wine	31.5	21.1	13.4	66.0	2.10
New York Apple Association	1.5	0.3	0.5	2.3	1.52
Public R&D - Apples (Cornell, CCE)	0.8	0.5	0.1	1.4	1.71
Total	**317.2**	**154.8**	**115.9**	**587.9**	**1.85**
Total Value Added ($ million)					
Agricultural support services	8.6	0.9	3.6	13.1	1.52
Fruit and nursery stock	5.8	0.3	1.9	8.0	1.38
Farm production	196.1	72.9	89.9	358.9	1.83
Processing (frozen canned, dehydrated)	140.4	179.0	95.5	414.9	2.95
Hard cider and apple wine	44.0	32.0	23.1	99.0	2.25
New York Apple Association	2.0	0.5	0.8	3.3	1.66
Public R&D - Apples (Cornell, CCE)	1.0	0.8	0.2	2.0	1.95
Total	**397.9**	**254.6**	**200.6**	**853.1**	**2.14**

Source: Implan (2016), author calculations

[1] Direct effects represent total activity (sales, employment, labor income, value added) by the respective industry.

[2] Indirect effects represent all activity by the backward-linked supply chain industries.

[3] Induced effects represent additional industry activity due to consumption out of labor income.

[4] For each industry, the sum of the direct, indirect, and induced effects equals the total effect. Summing the direct effects across industries will equal the total shown (from Table 10); however, summing the indirect and induced effects across industries will not as we account for existing inter-industry linkages within the apple supply chain.

[d] The implicit multiplier is calculated as the total effect divided by the direct effect.

DISTRIBUTIONAL IMPLICATIONS

While **Table 11** provides the total contributions of indirect and induced effects as a result of the individual and aggregate apply supply chain industries' direct contributions, it is useful to examine what industries contribute to those effects. In other words, examining the relative sizes of the backward linkages across industry sectors. The distribution of linkages, by industry, are described below for the aggregate apple industry supply chain. In addition, distributional linkages for individual apple farming and manufacturing (processing and hard cider combined) industries are included in **Appendix F** (**Figures F1 – F4**).[19]

Figure 11 and **Figure 12** provide the distribution of indirect and induced effects, by industry, generated by all apple industry supply chain (direct) activities. Industries are aggregated to the 2-digit NAICS level and the distributions are provided for output and employment, respectively. In general, the ordering of industries from left to right follow from production sectors on the left to service sectors on the right. In between are industries such as utilities, construction, manufacturing, wholesale trade, retail trade, and transportation and warehousing. While the relative magnitudes of effects are similar across industries for output (Figure X) and employment (Figure X), they are not identical due to differences in employment requirements (per dollar of output) across sectors.

The indirect effects (in blue) and induced effects (in orange) are separated to highlight the degree to which the effects derive from apple supply chain industry intermediate input demands versus industry effects accruing from labor income spending. Considering the indirect effects more closely is useful to understand the business-to-business transactions in the state promulgated by the apple industry supply chain. In deference, spending out of labor income is invariant to where the direct effect occurs (i.e., household spending is the same whether the labor income came from an apple supply chain industry or not). Accordingly, much of the discussion below highlights the indirect industry effects.

Wholesale trade has the highest backward linkages (for output and employment). This makes intuitive sense as many input purchases by farms, processors, and other sectors are from wholesale distributors, rather than retail establishments. The contribution to wholesale trade represents the wholesale margin only, and not the value of the products purchased from wholesalers, those will show up in relation to the industrial sectors from where they are produced. Not surprisingly, most of the impact to wholesale trade is derived from indirect effects. Manufacturing firms have the next highest level of linkage effects, almost entirely from indirect effects, and represent either direct purchases from local manufacturers or the margined component from wholesale and retail trade purchases of the manufactured product value, to the degree that they are local.

The direct apple supply chain sectors purchase a relatively small amount from other agricultural production sectors, and are comprised primarily of non-apple fruits and vegetables (not shown) for processing and/or resale. Other business support sectors such as transportation and warehousing, finance and insurance, and contracted professional services (e.g., management, accounting, legal) make up the bulk of remaining indirect effects to the apple supply chain. The largest induced effects follow intuitively from major household budget allocations; i.e., insurance, real estate (rent and imputed rental value for owned homes), healthcare, dining, and various retail purchases (e.g., food, clothing, etc.).

[19] Recall that when examining individual apple industry sectors, backward linkages to other apple industry sectors are included in the results; e.g., the apple support service industry is backward linked to apple farming, and apple farming is backward linked to apple manufacturing. When the distribution of linkages are examined for the entire apple industry supply chain, those apple-specific indirect effects are encompassed within the direct effects specified.

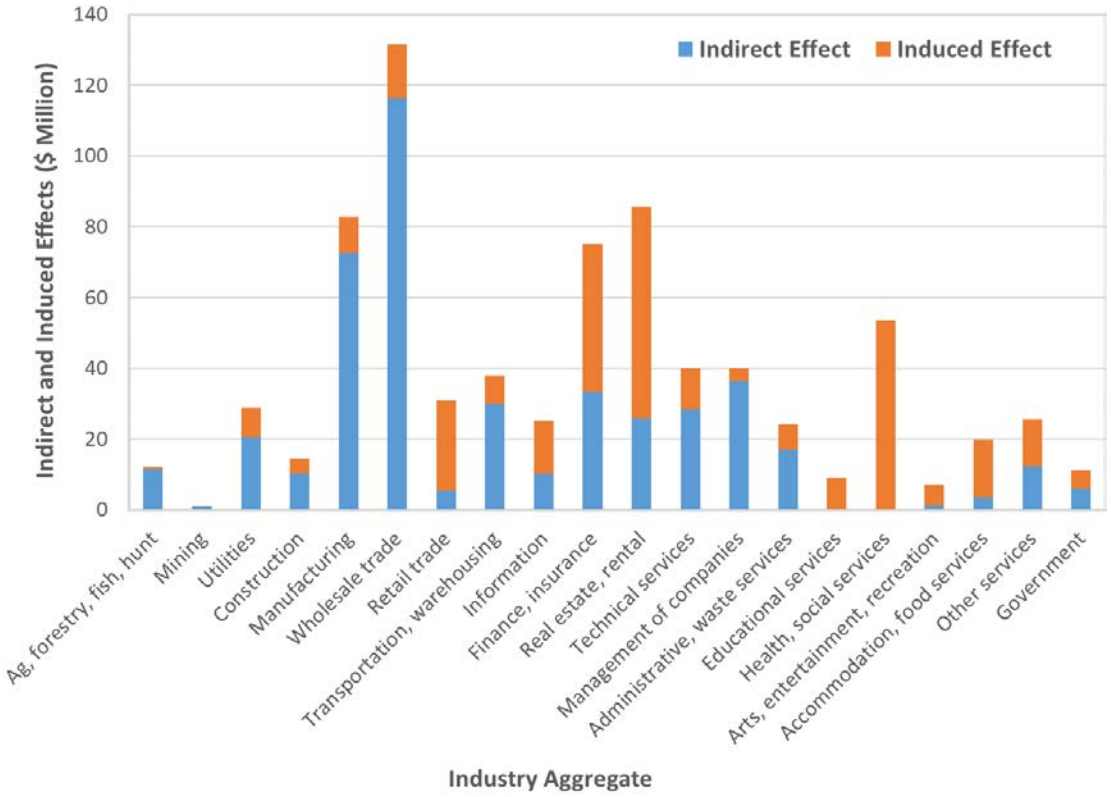

Figure 11. Indirect & induced output effects from apple industry supply chain, New York.

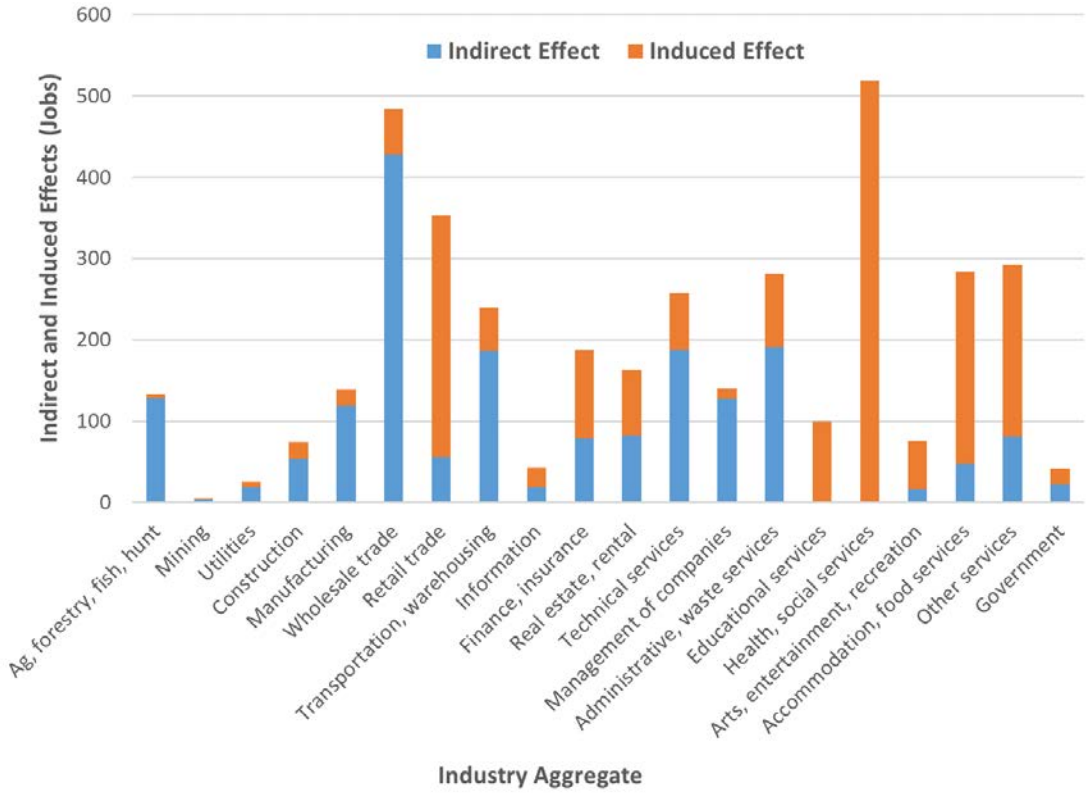

Figure 12. Indirect and induced employment effects from apple industry supply chain, New York.

CONCLUSIONS

NYS produces over 10% of all apples produced in the United States. Apple production in 2016 was nearly 1.2 billion pounds, valued at over $317 million, and marketed through a variety of fresh market and processing industry channels. Weather plays a large hand in year-to-year production volume; however, farm production continues to trend upward. In the face of a decreasing trend in acres, shifts to alternative technologies and production systems with higher density plantings are evident.

When viewed through the lens of the total fruit and vegetable canning in the state (where apple processing is an important part), the industry is continuing its recent trends of consolidation and contraction, as the value of total ouput and capital investments exhibit relatively strong reductions (in constant dollar terms) over the last available Census years. In comparision, Michigan's processing industry withnessed strong growth, while Pennsylvania and Washington exhibited strong contraction. In Washington, establishment numbers and employees had declines (on a percentage basis) greater than those in New York, with an implied reduction in payments to owners of 40% over this time period. Only New York's reduction of 55% was larger.

Economic contribution analyses identify the portion of a region's economy that can be attributed to an existing industry or combination of industries through its direct, indirect and induced effects. A comprehensive definition of the apple industry in NYS was constructed to include apple producers, processors (frozen, canned, wine, cider), support service providers (packing, grading, storage), and apple-centric public research activities. A customized economic input-output model was developed to assess economic contributions of individual and aggregate industries across a number of metrics.

In 2016 dollars, the aggregate NYS apple industry directly contributes $1.3 billion in total output, 8,033 jobs, and $397.9 million in gross domestic product (GDP) to the New York State economy. When backward-linked supply chain business-to-business transactions (indirect effects) and household spending out of labor income (induced effects) are considered, these values grow to $2.1 billion, 11,872 jobs, and $853.1 million, respectively. The results imply relatively strong multiplier effects for the industry, whereby every $1 of direct output in the apple industry generates an additional $0.58 in backward linked (non-apple) industry output, every direct job generates an additional 0.48 jobs, and every $1 of direct GDP generates an additional $1.14 in GDP from related business activity in the state. Individual supply chain sector estimates reveal strong economic linkages between apple industry firms in the state.

The general objectives of this research were to better understand the apple industry's total economic contributions to the NYS economy and to demonstrate the strong ripple (multiplier) effects the industry has given its strong backward-linked supply chain effects and related industry spending out of labor income generated in the apple industry. In addition, a closer examination of the distribution of the indirect and induced effects promotes a better understanding with what sectors these ripple effects arise from. While individual industries with strong ripple effects in the state may be desirable industries to target for expansion from a policy perspective, it is important to emphasize that the sizes of these multipliers says nothing about the likelihood or means by which they will/can be expanded. The likelihood of expansion of the sectors depends on where markets may be expanding and the extent to which these are the ones in which the multipliers are large. The extent to which public policy can help in expanding opportunities is also important.

Throughout this report we have examined the several multiplier effects associated with the various apple-based economic sectors in NYS. In closing, however, it is important to re-emphasize that it is most

appropriate to use these multipliers to examine the impact of marginal (rather small) changes in any particular industry. Relatively large changes in an industry are most likely to be accompanied by structural changes in the nature of the economy's inter-industry transactions. Under these conditions, it may be more problematic to base estimates of the economic impacts on current estimates of economic multipliers.

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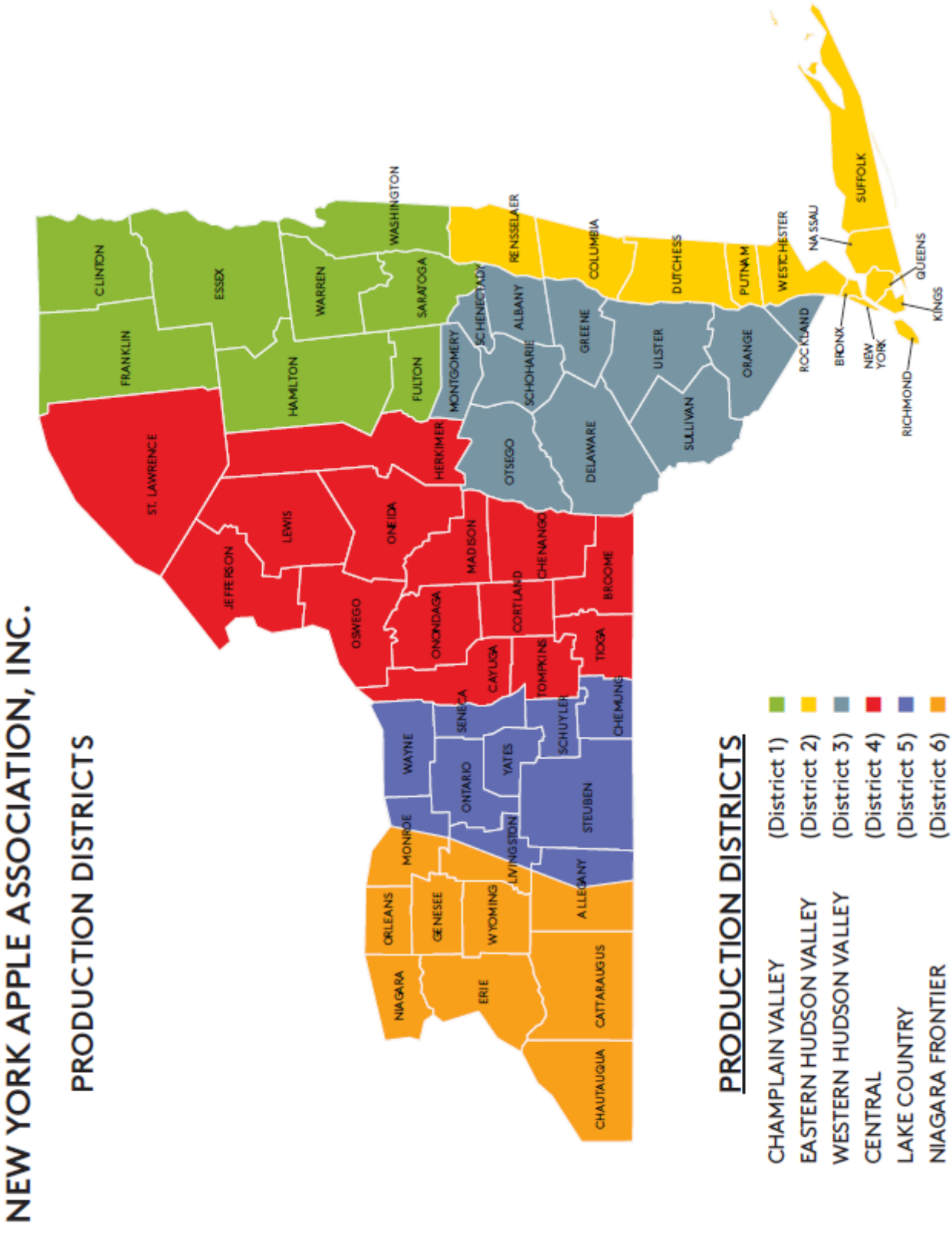
APPENDIX A
APPLE GROWING REGIONS IN NEW YORK STATE



APPENDIX A
APPLE GROWING REGIONS IN NEW YORK STATE

Table A1. Number of apple operations and acres by New York Apple Association Production District.		
Districts and Counties	**Operations**	**Acres**
Champlain Valley: Clinton, Essex, Franklin, Hamilton, Washington, Saratoga, Fulton	126	3,926
Eastern Hudson Valley: Rensselaer, Columbia, Dutchess, Putnam, Westchester, Queens, Suffolk	133	2,530
Western Hudson Valley: Montgomery, Schenectady, Albany, Schoharie, Otsego, Greene, Delaware, Ulster, Sullivan, Orange, Rockland	234	6,423
Central: St. Lawrence, Jefferson, Lewis, Herkimer, Oneida, Oswego, Onondaga, Madison, Cayuga, Cortland, Chenango, Tompkins, Tioga, Broome	282	2,865
Lake Country: Wayne, Ontario, Seneca, Yates, Schuyler, Chemung, Steuben	322	21,459
Niagara Frontier: Niagara, Orleans, Monroe, Genesee, Wyoming, Livingston, Erie, Chautauqua, Cattaraugus, Allegany	272	9,657
Total	**1,369**	**46,860**
Source: New York State Apple Association, USDA (2017d)		

Table A2. Number of apple operations and acres by county.		
District/County	**Operations**	**Acres**
Champlain Valley		
Clinton	16	2,730
Essex	8	205
Franklin	19	59
Hamilton	6	(D)
Washington	38	600
Saratoga	30	332
Fulton	9	(D)
Eastern Hudson Valley		
Rensselaer	23	290
Columbia	34	1,579
Dutchess	37	378
Putnam	5	(D)
Westchester	5	(D)
Queens	1	(D)
Suffolk	28	283
Western Hudson Valley		
Montgomery.	14	45
Schenectady	6	24
Albany	15	134
Schoharie	20	222
Otsego	27	97
Greene	19	64
Delaware	26	29
Ulster	68	4,819
Sullivan	12	45
Orange	23	867

Rockland	4	77

Appendix Table A2. Number of apple operations and acres by county (continued).

District/County	Operations	Acres
Central		
St. Lawrence	47	219
Jefferson	29	235
Lewis	4	5
Herkimer	8	44
Oneida	15	413
Oswego	30	803
Onondaga	27	611
Madison	21	44
Cayuga	29	188
Cortland	4	2
Chenango	28	87
Tompkins	17	98
Tioga	9	68
Broome	14	48
Lake Country		
Wayne	197	20,387
Ontario	16	543
Seneca	22	106
Yates	21	162
Schuyler	21	62
Chemung	17	152
Steuben	28	47
Niagara Frontier		
Niagara	68	2,663
Orleans	67	5,475
Monroe	29	1,126
Genesee	6	10
Wyoming	8	30
Livingston	11	42
Erie	20	51
Chautauqua	40	188
Cattaraugus	12	39
Allegany	11	33

Source: New York State Apple Association, USDA (2017d)

APPENDIX B
PROCESSED APPLE UTILIZATION AND PRICES

Table B1. Processed apple utilization and marketing year average prices, New York, 2000-2016.[1]

	Total		Canned		Juice & Cider		Frozen[2]		Other[2]	
Year	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price
2000	475	130	246	158	189	88	26	168	14	128
2001	520	133	320	152	155	86	30	150	15	164
2002	320	153	228	166	65	100	20	182	7	120
2003	550	134	270	150	200	104	50	164	30	132
2004	620	139	340	156	200	96	50	228	30	84
2005	545	141	290	156	180	88	40	174	35	
2006	560	152	300	172	190	112	50	181	20	
2007	610	174	330	174	210	145	50	252	20	
2008	690	259	380	268	210	190			100	234
2009	675	168	335	190	280	116			60	100
2010	710	209	345	214	260	168			65	
2011	680	199	330	212	270	170			50	
2012	375	369	190	540	155	170				
2013	740	193	325	197	340	140				
2014	625	188	249	200	318	134				
2015	635	205	264	205	307	170				
2016	520	229	220	224	260	205				

Source: USDA (2017b)

[1] Packinghouse door equivalent. Quantities expressed in million pounds, prices in dollars per ton. Empty cells indicate no data available or withheld due to disclosure issues.

[2] Other includes vinegar, wine, and slices for pie making. Frozen and Other categories not reported in 2014 and later.

APPENDIX C
APPLE FARM SURVEY INSTRUMENTS

DATE INITIAL LETTER

RE: Measuring the Economic Contributions of Apple Industry Supply Chain in New York State

Dear New York State Apple Producer:

How much impact does apple production and its related supply chain firms have on New York State's economy? Most of the impact that you as a local producer have on the economy has to do with where you purchase your inputs, where you hire the labor and services you use, and where your products are sold. Supported by a grant from the New York State Apple Association, we are asking a sample of producers within the state to complete a survey about these activities in order to provide current and comprehensive estimates of the apple industry's impacts. The project will provide important metrics on jobs supported, output levels, and contributions to state domestic product. Unfortunately, the data necessary to conduct this in a comprehensive way are unavailable from traditional sources. With better data and an up-to-date economic analysis, producers, agribusiness firms, and policymakers will be better able to understand the contribution this industry has and to make more informed decisions regarding the support of alternative economic development options looking forward.

It is important in this survey that you provide the most **accurate and specific data** possible regarding your operation's purchasing and sales activities. Individual survey responses will be kept **strictly confidential** and any reporting of results will be based on aggregate statistics from which no individual data can be derived. We recognize that you are very busy, however, we would greatly value your participation in this important study. Please complete the survey by **July 20, 2016** by going to the protected online link provided below. The survey provides you the opportunity to complete it over multiple sessions. Just be sure to click 'submit' when you have completed entering information. Alternatively, if you would prefer a paper version of the survey, please let us know and we will send you a copy through the mail. If you have any questions, concerns, or would like additional information please feel to contact any of us.

We expect the results of the survey will be of great interest to both you and the apple industry in general. There is a section at the end of the survey offering you the option to include your contact information for which we will happily send you a copy of our final report. Again, please return your survey by **July 20, 2016**. Your contribution to this research effort is greatly appreciated!

APPLE SURVEY LINK: http://www.nyapplesurvey.com/

Sincerely,

Todd M. Schmit — Associate Professor, Charles H. Dyson School of Applied Economics and Management, Cornell University, 350A Warren Hall, Ithaca, NY 14853, 607-255-3015, tms1@cornell.edu

Jesse Strzok — Production Economist, Eastern New York Commercial Horticulture Program, Cornell Cooperative Extension, 415 Lower Main Street, Hudson Falls, NY 12839, 518-429-1464, js3234@cornell.edu

Jose Barros — Research Assistant, Charles H. Dyson School of Applied Economics and Management, Cornell University, 364 Warren Hall, Ithaca, NY 14853, 612-806-3412, jb2487@cornell.

APPENDIX C
APPLE FARM SURVEY INSTRUMENTS
2016 NEW YORK STATE APPLE SUPPLY CHAIN ECONOMIC IMPACT STUDY – PRODUCER SURVEY

(Survey Number: _____)

BACKGROUND INFORMATION

1. In which county is your farm located? _____ COUNTY

2. How long have you owned and operated your own farm (current and previous)? _____ years

3. Please indicate the business organization type of your farm. (Check one)

Business Organization Form	Check One
Sole Proprietorship	
Partnership	
C or S Corporation	
LLC	
Other (please describe):	

4. Please list the types of crops you grow and sell (e.g., apples, tart cherries, melons, tomatoes, etc.):

- List: _____
- List: _____
- List: _____
- List: _____

5. What was the average number of paid employees your farm had over the last three years? How many of those employees resided in New York State? **Include both full-and part-time employees as indicated below.*

Employee classification	Number
Total full time employees	
Full time employees that were New York State residents	
Total part time and seasonal employees	
Part time and seasonal employees that were New York State residents	

6. Please provide your farm's average annual acreage by type of crop/use over the last three years

Land type	Acres
Total acres in all uses (e.g., actively farmed, forested, fallow, pasture, buildings)	
Acres in apples – Non-Club varieties	
Acres in apples – NYS Club varieties	
Acres in apples – non-NYS Club varieties	
Acres in other fruits	
Acres in vegetables	
Acres in corn, soybeans, forage, and other crops	
Acres in forests/woods	
Acres fallow and/or pasture	
Acres on building sites	

Acres in other (please describe):	

7. What production methods are employed on your farm? (check all that apply)

Production methods	Check All That Apply
Conventional production	
Certified organic production	
Transitioning to organic production	
Other (please describe):	

8. On average, what were the annual level of capital investments (in dollars), by category, made by your farm over the last three years? What percent of those purchases were made from firms/sellers in New York State?

Capital Investment Type	Dollars ($)	Percent of purchases from NYS firms (0-100%)
Nonresidential buildings and structures		
Residential buildings and structures		
Machinery and equipment		
Investments in other businesses		
Farm land		
Other (please describe):		

SOURCES OF DOLLAR INFLOWS

This part of the survey will ask questions about the level of earnings from your farm operation in total as well as by type of product, along with the market channels through which you market your apples. The information is necessary to estimate what industries/sectors generate dollar inflows to apple producers in the state. We also ask what percent of the earnings are generated from buyers in New York State to differentiate inflows of dollars from in-state and out-of-state sources.

9a. What was your farm's average total gross earnings from operations (before income taxes) over the last three years?

- **$_____ Total earnings from farm operations (Round to the nearest dollar)**

9b. Please provide the dollar value (3-year average) of the individual sources of those earnings by type of product, along with the percentage of those earnings (0-100%), that occurred within New York State. It may be easiest if you complete the 'Dollars' column first where the sum of all categories should equal the total earnings from farm operations you provided in question 9a, and then complete the 'Percent' column to indicate by category (row) the percentage of those earnings that occur within NYS. Any categories not applicable can be left blank.

APPENDIX C
APPLE FARM SURVEY INSTRUMENTS

Farm earnings classification by type of product	Dollars ($)	Percent in NYS* (0-100%)
Fresh apple sales, NYS Club varieties:		
Fresh apple sales, Other Club varieties:		
Fresh apple sales, Non-Club varieties:		
Fresh apple sales, Unknown/other		
Processed apple product sales, Cider		
Processed apple product sales, Juices		
Processed apple product sales, Sauces, jams, jellies		
Processed apple product sales, Slices		
Processed apple product sales, Unknown/other		
Other fresh fruit sales		
Other processed fruit product sales, all types		
Fresh vegetable sales		
Processed vegetable product sales, all types		
Other crop sales - Nursery stock		
Other crop sales (please describe):		
Non-crop sales - livestock/meat/egg sales		
Non-crop sales - Rental income:		
Non-crop sales - Professional services (e.g., crop spraying)		
Non-crop sales - Government payments:		
Non-crop sales - Other (please describe):		
Total earnings from farm operations (should equal answer in 9a)		

* Sales locations should ideally reflect where geographically your products are destined for consumption or processing; however, this is sometimes unknown. If you know the operating location of the buying agent/firm (e.g., a food processing plant in NYS, a grocery store in your home-town, or a local food distributor in your county), use their location when answering this question. If the buyer's place of operation or residence is unknown (e.g., consumers at a farmers' market, or wholesale auction barn) use the location of where the sales take place as your location reference.

9c. Now please provide the dollar value (3-year average) of the individual sources of **apple product sales** (including fresh, processed, and nursery stock sales) by market channel utilized, along with the percentage of those earnings (0-100%), that occurred within New York State. It may be easiest if you complete the 'Dollars' column first (where the sum of all categories should equal the total of the fresh and processed apple sales rows from 9b) and then complete the 'Percent' column to indicate by category (row) the percentage of those earnings that occur within NYS. *Direct to Consumer* sales are defined as direct sales you make directly to the individual consumer buyers through a variety of outlets. *Direct to Intermediary* sales involve selling to buyers who package or process products for sale or re-sell fresh products purchased from you. *Commodity* sales generally refer to non-differentiated product sales to traditional buyers through auctions, associations, or other markets. Any categories not applicable can be left blank.

APPENDIX C
APPLE FARM SURVEY INSTRUMENTS

APPLE sales by type of market channel	Dollars ($)	Percent in NYS* (0-100%)
Direct to Consumer, Pick your own (u-pick)		
Direct to Consumer, Own site (farm stand, retail store)		
Direct to Consumer, Farmers markets		
Direct to Consumer, Internet/mail order		
Direct to Consumer, Community Supported Agriculture (CSA)		
Direct to Consumer, Other (please describe):		
Direct to Intermediary – Packer, distributor, non-processor food hub		
Direct to Intermediary – Food processor		
Direct to Intermediary – Grocery store, specialty store		
Direct to Intermediary – Restaurants, caterers		
Direct to Intermediary – Schools, other institutions		
Direct to Intermediary – Other Farms		
Direct to Intermediary – Other (please describe)		
Commodity Sales – Produce auction/market		
Commodity Sales – Farmer cooperative, marketing association		
Commodity Sales – Other (please describe):		
Total apple and apple product sales		

* Sales locations should ideally reflect where geographically your products are destined for consumption or processing; however, this is sometimes unknown. If you know the operating location of the buying agent/firm (e.g., a food processing plant in NYS, a grocery store in your home-town, or a local food distributor in your county), use their location when answering this question. If the buyer's place of operation or residence is unknown (e.g., consumers at a farmers' market, or wholesale auction barn) use the location of where the sales take place as your location reference.

DESTINATION OF DOLLAR OUTFLOWS

10. **INTERMEDIATE INPUT EXPENDITURES**: This part of the survey will ask you questions about the types of inputs that your farm purchases and if the purchases are made within New York State. For each intermediate input category, indicate the average level (dollars) of total expenses over the last three years, along with an estimate of the percentage of those expenses that were paid to firms in New York State. It may be easiest if you complete the 'Expenditure' column first, and then complete the percent column by assigning the percentage of those expenses (by row) that occur in New York State. Intermediate input expenditures include all expenses related to the categories below. They exclude payments for business taxes, employee compensation, and payments to owners and/or investors, which are covered in the later sections of the survey. Categories where "(nonemployee)" is included is for costs paid to nonemployees of the farm (e.g., independent contractors, other businesses, etc.). Any categories not applicable can be left blank.

APPENDIX C
APPLE FARM SURVEY INSTRUMENTS

Intermediate Input Expenditure Category	Expenditure (dollars)	% paid to NYS firms* (0 - 100%)
Fuel, oil, and grease purchases from:	*Includes petroleum, oil, grease, and related products*	
Manufacturers	$	
Wholesalers / Distributors	$	
Retailers	$	
Maintenance and repair costs for:	*Separate for equipment and structures/real estate*	
Automobiles, machinery, equipment	$	
Structures (buildings, real estate)	$	
Rental and leasing costs for:	*Separate for equipment and structures/real estate*	
Automobiles, machinery, equipment	$	
Structures (buildings, real estate)	$	
Insurance (excluding employee-related benefits)	$	
Utilities (electric, gas, water sewer)	$	
Telecommunications (wired, internet, phone)	$	
Contract management services (nonemployee; accounting, record keeping, legal services)	$	
Contracted crop services (nonemployee; land tillage, crop spraying, monitoring, harvesting)	$	
Contracted packing, sorting, and grading services (nonemployee)	$	
Contracted product storage and warehousing services (nonemployee)		
Contracted transportation and distribution services (nonemployee; truck, air, rail transport)	$	
Purchases of packaging materials from:	*Includes paper/plastic/glass containers, cardboard boxes, plastic wrap, paper products, etc.*	
Manufacturers	$	
Wholesalers / Distributors	$	
Retailers	$	
Purchases of seeds, plants, & nursery stock from:		
Other farmers	$	
Manufacturers	$	
Wholesalers / Distributors	$	
Retailers	$	
Purchases of fertilizer and lime inputs from:		
Manufacturers	$	
Wholesalers / Distributors	$	
Retailers	$	
Purchases of insecticides, herbicides and fungicides from:		
Manufacturers	$	
Wholesalers / Distributors	$	
Retailers	$	
Finance costs (interest, finance charges)	$	
Food service & accommodations (meals, hotels)	$	
Intermediate Input Expenditure Continued Next Page		

Intermediate Input Expenditure Category	Expenditure (dollars)	% paid to NYS firms* (0 - 100%)
Other intermediate input crop expenses:	*Please describe*	
	$	
Other intermediate input non-crop expenses:	*Please describe*	
	$	
Total intermediate input expenditures	**$**	

* Purchase locations should ideally reflect where the places of business you buy the inputs or services from are located. For example, if your plant/nursery stock supplier is located within NYS, you would enter '100%' in the '% paid to NYS firms' cell'. If you buy one-half of these inputs (in dollars) within NYS and the other one-half outside NYS, you should put '50%' in the '% paid to NYS firms cell for that category. If the seller's place of business is unknown, use the location of where the purchases take place as your location reference.

11. **EMPLOYEE COMPENSATION**: What were the farm's average total employee compensation costs over the last three years? The total should include wages, salaries, and fringe benefits (e.g., insurance, retirement, etc.) paid.

- $_____ Total employee compensation costs of full time employees
- $_____ Total employee compensation costs of part time and seasonal employees

12. **TAXES ON PRODUCTION AND IMPORTS**: Include the average level of business taxes and fees paid to governments by the farm business over the last three years, including sales and excise taxes, but excluding business income taxes, along with an estimate of the percentage of those taxes that were paid to NYS taxing authorities.

- $_____ Total taxes paid on production and imports
- _____ Percent of these taxes paid to government taxing authorities in NYS

13. **NET PROCEEDS BEFORE INCOME TAXES**: Indicate the farm's average level of net income before income taxes paid to local, state, and federal taxing authorities over the last three years. This should equal total farm earnings (question 9a), less total intermediate input expenditures (question 10), total employee compensation costs (question 11), and total business taxes on production and imports (question 12).

- $_____ Net proceeds before income taxes

14. **INCOME TAX EXPENSE**: Indicate the farm's average level of income taxes paid over the last three years, along with an estimate of the percentage of those income taxes that were paid to NYS taxing authorities

- $_____ Farm business income taxes paid
- _____ Percent of income taxes paid to government taxing authorities in NYS

15. **NET PROCEEDS AFTER TAXES**: Indicate the farm's average level of net income after income taxes paid to local, state, and federal taxing authorities over the past three years. This should equal net proceeds before income taxes (question 13) less income tax expense (question 14).

- $_____ Net proceeds after income taxes

APPENDIX C
APPLE FARM SURVEY INSTRUMENTS
MARKETING ACTIVITIES AND FUTURE POTENTIAL

This part of the survey gathers information identifying changes made in your marketing mix in selling your products within the state. It also asks about your intentions to expand production capacity in the next three years.

16. In the last three years, by how much have your farm's apple sales changed? Please differentiate changes by sales of apples for fresh or processed markets, and to buyers within or outside of NYS. Note, changes can be positive, zero, or negative.

Apple sales category	% change in sales
Change in fresh apple sales to NYS buyers for fresh markets	
Change in fresh apple sales to NYS buyers for processed markets	
Change in processed apple product sales to NYS buyers	
Change in fresh apple sales to buyers outside of NYS for fresh markets	
Change in fresh apple sales to buyers outside of NYS for processed markets	
Change in processed apple product sales to buyers outside of NYS	

17. In the next three years, by how much do you expect your farm's apple sales to change? Please differentiate changes by sales of apples for fresh or processed markets, and to buyers within or outside of NYS. Note, expected changes can be positive, zero, or negative

Apple sales category	% change in sales
Expected change in fresh apple sales to NYS buyers for fresh markets	
Expected change in fresh apple sales to NYS buyers for processed markets	
Expected change in processed apple product sales to NYS buyers	
Expected change in fresh apple sales to buyers outside of NYS for fresh markets	
Expected change in fresh apple sales to buyers outside of NYS for processed markets	
Expected change in processed apple product sales to buyers outside of NYS	

18. Feel free to use the space below to provide any additional comments. You can also contact any one of the Cornell researchers involved in the project using their contact information included in the cover letter to the survey.

_____
_____
_____
_____

If you would like to receive a copy of the final report for this research project, please contact the New York Apple Association.

Thank you for taking the time to complete this survey!

Your responses will help to provide important and accurate metrics regarding the economic contributions of the apple industry supply chain in New York State.

APPENDIX C
APPLE FARM SURVEY INSTRUMENTS

DATE – REMINDER LETTER, WITH TIME EXTENSION

Measuring the Economic Contributions of Apple Industry Supply Chain in New York State

SURVEY DEADLINE FAST APPROACHING!!

Dear New York State Apple Business:

You were recently sent a request from us on behalf of the New York Apple Association (NYAA) to complete a market and financial survey about your business. The information will be kept strictly confidential, presented in only aggregate form, and is important in providing a comprehensive analysis of the economic contribution of the apple industry supply chain in the state. The research is being funded by the NYAA and will also provide critical input to their current strategic planning processes. The survey can be completed online (**www.nyapplesurvey.com**), with a paper copy (and mailed back to us), or by requesting a sit-down (or phone) appointment with one of our research study staff. A hard copy of the survey can be downloaded from **www.nyapplesurvey.com** or we are happy to send you one, along with a postage paid return envelope. No one else will have access to this data and all information presented will be made in aggregate form so that no individual data can be extracted.

The survey deadline of **August 26, 2016** is fast approaching. If you have already completed your survey, thank you for your participation. If you haven't, please do so as soon as possible. Upon going to the link below, select either the "Apple Producer Survey" (for farms producing apples) or the "Apple Intermediary Survey" (for firms that process, pack, grade, store, or otherwise handle apples and apple products). If your operation both produces and processes/packs/stores/grades apples you DO NOT need to complete both surveys IF all of the activities and financial information is included in one survey (e.g., if you are an apple farm that also makes cider, you should just complete the apple producer survey). However, if you are involved in separate businesses that fit into each survey category, then both surveys should be completed based on the separate business activities (e.g., if you are an apple farm and are also involved in a separate apple storage business, then the former business should complete the apple producer survey and the latter business should complete the intermediary survey). If you have any questions along the way, please feel free to contact us so that we can navigate you appropriately.

Thanks in advance for your assistance in completing this important research!

http://www.nyapplesurvey.com/

Sincerely,

Todd M. Schmit, Associate Professor, Charles H. Dyson School of Applied Economics and Management, Cornell University, 350A Warren Hall, Ithaca, NY 14853, 607-255-3015, tms1@cornell.edu

Jesse Strzok, Production Economist, Eastern New York Commercial Horticulture Program, Cornell Cooperative Extension, 415 Lower Main Street, Hudson Falls, NY 12839, 518-429-1464, js3234@cornell.edu

APPENDIX D
APPLE FARM INTERMEDIARY SURVEY INSTRUMENTS

DATE, INITIAL LETTER

RE: Measuring the Economic Contributions of Apple Industry Supply Chain in New York State

Dear New York State Apple Business:

How much impact does apple production and its related supply chain firms have on New York State's economy? Most of the impact that your firm has on the economy has to do with where you purchase your inputs, where you hire the labor and services you use, and where your products are sold. Supported by a grant from the New York Apple Association, we are asking a sample of apple-related firms within the state to complete a survey about these activities in order to provide current and comprehensive estimates of the apple industry's impacts. The project will provide important metrics on jobs supported, output levels, and contributions to state domestic product. Unfortunately, the data necessary to conduct this in a comprehensive way are unavailable from traditional sources. With better data and an up-to-date economic analysis, producers, agribusiness firms, and policymakers will be better able to understand the contribution this industry has and to make more informed decisions regarding the support of alternative economic development options looking forward.

It is important in this survey that you provide the most **accurate and specific data** possible regarding your operation's purchasing and sales activities. Individual survey responses will be kept **strictly confidential** and any reporting of results will be based on aggregate statistics from which no individual data can be derived. We recognize that you are very busy, however, we would greatly value your participation in this important study. Please complete the survey by **August XX, 2016** by going to the online link provided below and following the directions to our protected online survey. The survey provides you the opportunity to complete it over multiple sessions. Just be sure to click 'submit' when you have completed entering information. Alternatively, if you would prefer a paper version of the survey, please let us know and we will send you a copy through the mail (one is also available to download on the first page of the online survey). If you have any questions, concerns, or would like additional information please feel to contact any of us.

We expect the results of the survey will be of great interest to both you and the apple industry in general. Please contact the New York Apple Association to obtain a copy of our final report. Again, please return your survey by **August XX, 2016**. Your contribution to this research effort is greatly appreciated!

WEBSITE LINK TO APPLE SURVEY: http://www.nyapplesurvey.com/

Sincerely,

Todd M. Schmit — Associate Professor, Charles H. Dyson School of Applied Economics and Management, Cornell University, 350A Warren Hall, Ithaca, NY 14853, 607-255-3015, tms1@cornell.edu

Jesse Strzok — Production Economist, Eastern New York Commercial Horticulture Program, Cornell Cooperative Extension, 415 Lower Main Street, Hudson Falls, NY 12839, 518-429-1464, js3234@cornell.edu

Jose Barros — Research Assistant, Charles H. Dyson School of Applied Economics and Management, Cornell University, 364 Warren Hall, Ithaca, NY 14853, 612-806-3412, jb2487@cornell.edu

APPENDIX D
APPLE FARM INTERMEDIARY SURVEY INSTRUMENTS

2016 NEW YORK STATE APPLE SUPPLY CHAIN ECONOMIC IMPACT STUDY –BUSINESS SURVEY

(Survey Number: _____)

BACKGROUND INFORMATION

1. Please indicate the general classifications of your firm within the apple industry supply chain based on its activities. (Check all that apply)

Apple Industry Classification	Check All That Apply
Processing	
Sorting, grading, and packing	
Storage	
Other (please describe):	

2. For processing firms please list the different types of products you sell (e.g., apple sauce, apple slices).

_____
_____
_____

3. In which county and state is your firm located?

_____ COUNTY
_____ STATE

4. How long has your firm been in operation (current and previous)? _____ years

5. Please indicate the business organization type of your firm. (Check one)

Business Organization Form	Check One
Sole Proprietorship	
Partnership	
C or S Corporation	
LLC	
Cooperative	
Other (please describe):	

6. Your firm's most recently audited financial statements are from what fiscal year?

_____ 2014
_____ 2015
_____ 2016

In which month does your firm's fiscal year begin?

_____ (Month)

7. **If your firm is a farmer-owned cooperative**, in what state is your cooperative headquartered and in what state is your cooperative incorporated in?

_____ Headquartered (State initials)
_____ Incorporated (State initials)

8. **If your firm is a farmer-owned cooperative**: How many total farmer members did your cooperative have in the last fiscal year? How many of those farmer members are located in New York State? How many non-farmer members and the number of those located in New York State?

_____ Total farmer members
_____ Total farmer members located in New York State
_____ Total non-farmer members
_____ Total non-farmer members located in New York State
(Describe non-farmer members: _____)

9. What was the average number of paid employees your firm had over the last three years? How many of those employees resided in New York State? **Include both full-and part-time employees as indicated below.*

Employee classification	Number
Total full time employees	
Full time employees that were New York State residents	
Total part time and seasonal employees	
Part time and seasonal employees that were New York State residents	

10. On average, what were the annual level of capital investments (in dollars), by category, made by your firm over the last three years? What percent of those purchases were made from firms/sellers in New York State?

Capital Investment Type	Dollars ($)	Percent of purchases from NYS firms (0-100%)
Nonresidential buildings and structures		
Residential buildings and structures		
Machinery and equipment		
Investments in other businesses		
Other (please describe):		

SOURCES OF DOLLAR INFLOWS

This part of the survey will ask questions about the level of earnings from your firm operation in total as well as by type of product, along with the market channels through which you market your apple products. The information is necessary to estimate what industries/sectors generate dollar inflows to apple businesses in the state. We also ask what percent of the earnings are generated from buyers in New York State to differentiate inflows of dollars from in-state and out-of-state sources.

11a. What was your firm's average total gross earnings from operations (before income taxes) over the last three years?

$_____ Total earnings from firm operations (Round to the nearest dollar)

11b. Please provide the dollar value (3-year average) of the individual sources of those earnings, by type of product or service. Include all that apply such that the sum of the earnings ($) by type equal total earnings from operations, in question 11a. Also include the percentage of each type of earnings (0-100%), that occurred within New York State. It may be easiest if you complete the 'Dollars' column first where the sum of all categories should equal the total earnings from farm operations you provided in question 11a, and then complete the 'Percent' column to indicate by category (row) the percentage of those earnings that occur within NYS. Any categories not applicable can be left blank.

Firm earnings classification by type of product or service	Dollars ($)	Percentage of earnings from NYS firms (%)
Sales of processed apple products		
Sauces		
Slices		
Juice		
Juice concentrate		
Cider (nonalcoholic)		
Hard cider		
Other (please describe):		
Other (please describe):		
Total sales of processed apple products		
Revenues from sorting, grading, and/or packing services		
Revenues from Storage services		
Other (please describe):		
Other (please describe):		

12. For processors, please indicate the level of total apple product sales that were made to following industry sectors. For each, please estimate the percentage of those sales that were to buyers located in New York State.

Firm earnings classification by type of product or service	Dollars ($)	Percentage of earnings from NYS firms (%)
Sales of processed apple products to:		
Farmers		
Other Processors		
Wholesalers and/or Distributors		
Retailers		
Consumers		
Hard cider		
Other firms (please describe):		
Other firms (please describe):		
Total sales of processed apple products		

(*Total dollars should equal the total of sales of processed apple products from question 11b above)*

13. **If your firm is a farmer-owned cooperative**, please indicate the total dollars received by the cooperative from members in the form of direct cash investments to help meet their member equity requirements.

    $_____ Total direct equity investment by members

    (Note, this should NOT include retained patronage refunds of members as this comes out of net income and is addressed later in the survey, but it should include direct cash investments to the cooperative from members and any capital retains to member equity accounts that not included in other sources of inflows in the earnings questions above.)

DESTINATION OF DOLLAR OUTFLOWS

14. **Intermediate input expenditure category:** This part of the survey will ask you questions about the types of inputs that your firm purchases and if the purchases are made within New York State. For each intermediate input category, indicate the average level (dollars) of total expenses over the last three years, along with an estimate of the percentage of those expenses that were paid to firms in New York State. It may be easiest if you complete the 'Expenditure' column first, and then complete the percent column by assigning the percentage of those expenses (by row) that occur in New York State. Intermediate input expenditures include all expenses related to the categories below. They exclude payments for business taxes, employee compensation, and payments to owners and/or investors, which are covered in the later sections of the survey. Categories where "(nonemployee)" is included is for costs paid to nonemployees of the farm (e.g., independent contractors, other businesses, etc.). Any categories not applicable can be left blank.

Intermediate Input Expenditure Category	**Expenditure** (dollars)	**% paid to NYS firms** (0 - 100%)
Purchases of apples and apple product input commodities from:	*This category refers to purchases of apples and/or apple products (e.g., concentrate) by the firm for further processing and/or resale.*	
Farmers	$	
Processors / Manufacturers	$	
Wholesalers / Distributors	$	
Retailers	$	
Purchases of ancillary food input commodities from:	*Ancillary food input commodities are defined as other food product ingredients procured by the firm in the production of processed products; e.g., flavorings, oils, spices, sugar.*	
Farmers	$	
Processors / Manufacturers	$	
Wholesalers / Distributors	$	
Retailers	$	
Purchases of packaging materials & chemical inputs from:	*Packaging materials include wood/paper/plastic/glass containers, cardboard boxes, plastic wrap, paper products, etc. Chemical inputs include cleaners, reagents, sanitation supplies, post-harvest and storage sprays, etc.*	
Processors / Manufacturers	$	
Wholesalers / Distributors	$	
Retailers	$	
Utilities (electric, gas, water sewer)	$	
Telecommunications (wired, internet, phone)	$	
Maintenance and repair costs for:	*Please separate for equipment and structures/real estate*	
Automobiles, machinery, equipment	$	
Structures (buildings, real estate)	$	
Insurance (excl. employee-related benefits)	$	
Contract management services (nonemployee; accounting, record keeping, legal services)	$	
Contract product storage/warehousing services (nonemployee)	$	
Contract transportation and distribution services (nonemployee; truck, air, rail transportation)	$	
Intermediate Input Expenditure Continued Next Page		

Intermediate Input Expenditure Category	Expenditure (dollars)	% paid to NYS firms* (0 - 100%)
Rental and leasing costs for:	*Please separate for equipment and structures/real estate*	
Automobiles, machinery, equipment	$	
Structures (buildings, real estate)	$	
Finance costs (interest, finance charges)	$	
Food service & accommodations (meals, hotels)	$	
Fuel, oil, and grease purchases from:	*Includes petroleum and related product purchases*	
Wholesalers	$	
Retailers	$	
Other intermediate input purchases:	*Please describe*	
	$	
	$	
	$	
	$	
	$	
Total intermediate input expenditures	**$**	

15. **Employee compensation:** What were the firm's average total employee compensation costs over the last three years? The total should include wages, salaries, and fringe benefits (e.g., insurance, retirement, etc.) paid.

$_____ Total employee compensation costs of full time employees
$_____ Total employee compensation costs of part time and seasonal employees

16. **Taxes on production and imports:** Include the average level of business taxes and fees paid to governments by the firm over the last three years, including sales and excise taxes, but excluding business income taxes, along with an estimate of the percentage of those taxes that were paid to NYS taxing authorities.

$_____ Total taxes paid on production and imports
_____ Percent of these taxes paid to government taxing authorities in NYS

17. **Net Proceeds before income taxes:** Indicate the firm's average level of net income before income taxes paid to local, state, and federal taxing authorities over the last three years. This should equal total firm earnings (question 11a), less total intermediate input expenditures (question 14), total employee compensation costs (question 15), and total business taxes on production and imports (question 16).

$_____ Net proceeds before income taxes

18. **Income tax expense:** Indicate the firm's average level of income taxes paid over the last three years, along with an estimate of the percentage of those income taxes that were paid to NYS taxing authorities

$_____ Firm business income taxes paid
_____ Percent of income taxes paid to government taxing authorities in NYS

19. **Net proceeds after taxes**: Indicate the firm's average level of net income after income taxes paid to local, state, and federal taxing authorities over the past three years. This should equal net proceeds before income taxes (question 17) less income tax expense (question 18).

$_____ Net proceeds after income taxes

20. **If your firm is a farmer-owned cooperative:**

20a. **Allocation of net proceeds after taxes:** Please indicate how the net proceeds of income after taxes were allocated on average over the last three years. Of particular importance to estimating economic impacts for cooperatives is how the residual income is distributed to its owners (members), in both the amount and form of distribution. Total dollars allocated should equal the net proceeds after taxes indicated above. Finally, estimate the percentage of those allocations to members (and non-members if applicable) residing in NYS.

Allocation of Net Proceeds After Taxes	**Expenditure** (dollars)	**% paid to NYS firms** (0 - 100%)
Dividends on Preferred Stock:		
Amount of net earnings distributed to members as dividends on preferred stock	$	
Amount of net earnings distributed to nonmembers as dividends on preferred stock	$	
Patronage to Members:		
Amount of net earnings distributed to members in cash patronage including credits applied to member bill	$	
Amount of net earnings distributed to members as qualified written notices of allocation (retained patronage)	$	
Amount of net earnings distributed to members as nonqualified written notices of allocation (retained patronage)	$	
Patronage to Non-Members (if applicable):		
Amount of net earnings distributed to nonmembers in cash patronage including credits applied to member bill	$	
Amount of net earnings distributed to nonmembers as qualified written notices of allocation (retained patronage)	$	
Amount of net earnings distributed to nonmembers as nonqualified written notices of allocation (retained patronage)	$	
Allocation to Unallocated Reserves:		
Amount of net earnings distributed to unallocated reserves in the cooperative (retained)	$	N/A
Other Allocations:		
Describe:	$	
Describe:	$	

20b. **Equity redemption:** Indicate the level of equity **redeemed** to members (and nonmembers if applicable) in the last fiscal year, along with an estimate of the percentage of the value of those redemptions that went to members located in NYS.

Equity Redemption	**Expenditure** (dollars)	**% paid to NYS firms** (0 - 100%)
Redemption to Members:		
Amount of equity redeemed to members in cash including credits applied to member bill	$	
Amount of equity redeemed to members as preferred stock	$	
Amount of equity redeemed to members as other (please describe) _____ _____	$	
Patronage to Non-Members (if applicable):		
Amount of equity redeemed to nonmembers in cash including credits applied to member bill	$	
Amount of equity redeemed to nonmembers as preferred stock	$	
Amount of equity redeemed to nonmembers as other (please describe) _____ _____	$	

OPTIONAL INFORMATION

Feel free to use the space below to provide any additional comments. You can also contact any one of the Cornell researchers involved in the project using their contact information included in the cover letter to the survey.

If you would like to receive a copy of the final report for this research project, please contact the New York Apple Association.

Thank you for taking the time to complete this survey!

Your responses will help to provide important and accurate metrics regarding the economic contributions of the apple industry supply chain in New York State.

APPENDIX D
APPLE FARM INTERMEDIARY SURVEY INSTRUMENTS

Measuring the Economic Contributions of Apple Industry Supply Chain in New York State

SURVEY DEADLINE FAST APPROACHING!!

DATE – REMINDER LETTER, WITH TIME EXTENSION

Dear New York State Apple Business:

You were recently sent a request from us on behalf of the New York Apple Association (NYAA) to complete a market and financial survey about your business. The information will be kept strictly confidential, presented in only aggregate form, and is important in providing a comprehensive analysis of the economic contribution of the apple industry supply chain in the state. The research is being funded by the NYAA and will also provide critical input to their current strategic planning processes. The survey can be completed online (**www.nyapplesurvey.com**), with a paper copy (and mailed back to us), or by requesting a sit-down (or phone) appointment with one of our research study staff. A hard copy of the survey can be downloaded from **www.nyapplesurvey.com** or we are happy to send you one, along with a postage paid return envelope. No one else will have access to this data and all information presented will be made in aggregate form so that no individual data can be extracted.

The survey deadline of **August 26, 2016** is fast approaching. If you have already completed your survey, thank you for your participation. If you haven't, please do so as soon as possible. Upon going to the link below, select either the "Apple Producer Survey" (for farms producing apples) or the "Apple Intermediary Survey" (for firms that process, pack, grade, store, or otherwise handle apples and apple products). If your operation both produces and processes/packs/stores/grades apples you DO NOT need to complete both surveys IF all of the activities and financial information is included in one survey (e.g., if you are an apple farm that also makes cider, you should just complete the apple producer survey). However, if you are involved in separate businesses that fit into each survey category, then both surveys should be completed based on the separate business activities (e.g., if you are an apple farm and are also involved in a separate apple storage business, then the former business should complete the apple producer survey and the latter business should complete the intermediary survey). If you have any questions along the way, please feel free to contact us so that we can navigate you appropriately.

Thanks in advance for your assistance in completing this important research!

http://www.nyapplesurvey.com/

Sincerely,

Todd M. Schmit, Associate Professor, Charles H. Dyson School of Applied Economics and Management, Cornell University, 350A Warren Hall, Ithaca, NY 14853, 607-255-3015, tms1@cornell.edu

Jesse Strzok, Production Economist, Eastern New York Commercial Horticulture Program, Cornell Cooperative Extension, 415 Lower Main Street, Hudson Falls, NY 12839, 518-429-1464, js3234@cornell.edu

APPENDIX E
NEW YORK STATE APPLE FARM PRODUCTION FUNCTION

Table E1. New York State apple farm production function and local purchase percentages.

Code	Description	Gross Absorption Value[1]	Local Purchase Percentage[2]
	Intermediate Input Purchases:		
3007	Fruit (for resale)	0.0226	100%
3006	Replacement nursery stock, trees, and plants	0.0127	17%
3049	Electricity transmission and distribution	0.0054	100%
3051	Water, sewage and other systems	0.0027	100%
3062	Maintenance & repair of nonresidential structures	0.0102	100%
3063	Maintenance & repair of residential structures (worker housing)	0.0029	100%
3156	Fuel and oil (production margin)	0.0192	1%
3169	Nitrogenous fertilizer (production margin)	0.0037	10%
3170	Phosphate fertilizer (production margin)	0.0037	6%
3172	Pesticides and other agricultural chemicals (producer margin)	0.0592	47%
3394	Miscellaneous manufacturing	0.0235	26%
3395	Wholesale trade (wholesale margin)	0.0790	95%
3399	Building and crop materials (retail margin)	0.0042	81%
3408	Air transportation (transport margin)	0.0008	58%
3409	Rail transportation (transport margin)	0.0005	45%
3410	Water transportation (transport margin)	0.0001	72%
3411	Truck transportation (hired and transport margin)	0.0078	91%
3413	Pipeline transportation (transport margin)	0.0001	17%
3416	Warehousing and storage services	0.0146	100%
3427	Telecommunications	0.0027	100%
3437	Insurance	0.0282	85%
3440	Real estate rental and leasing	0.0197	100%
3445	Machinery and equipment rental and leasing	0.0112	51%
3447	Legal services	0.0049	100%
3448	Accounting, bookkeeping, and payroll services	0.0049	100%
3457	Advertising and marketing services	0.0055	97%
3464	Employment expenses (H2A workers)	0.0153	100%
3507	Maintenance & Repair of equipment	0.0307	100%
	Total intermediate inputs	**0.3962**	74%
	Value Added Outlays:		
EC	Employee compensation	0.3266	--
PI	Proprietor income	0.1806	--
OPTI	Other property type income	0.0876	--
TOPI	Taxes on production and imports	0.0090	--
	Total value added	**0.6038**	**--**
	Total intermediate inputs and value added	**1.0000**	--

Source: Apple farm survey data and Fruit Farm Business Summary (Lake Ontario Fruit Team 2017).

[1] Dollars of expenditure or outlay per $1 of output.

[2] Local defined as purchases from New York State firms.

APPENDIX F
DISTRIBUTION OF INDIRECT AND INDUCED EFFECTS: APPLE FARMING AND MANUFACTURING

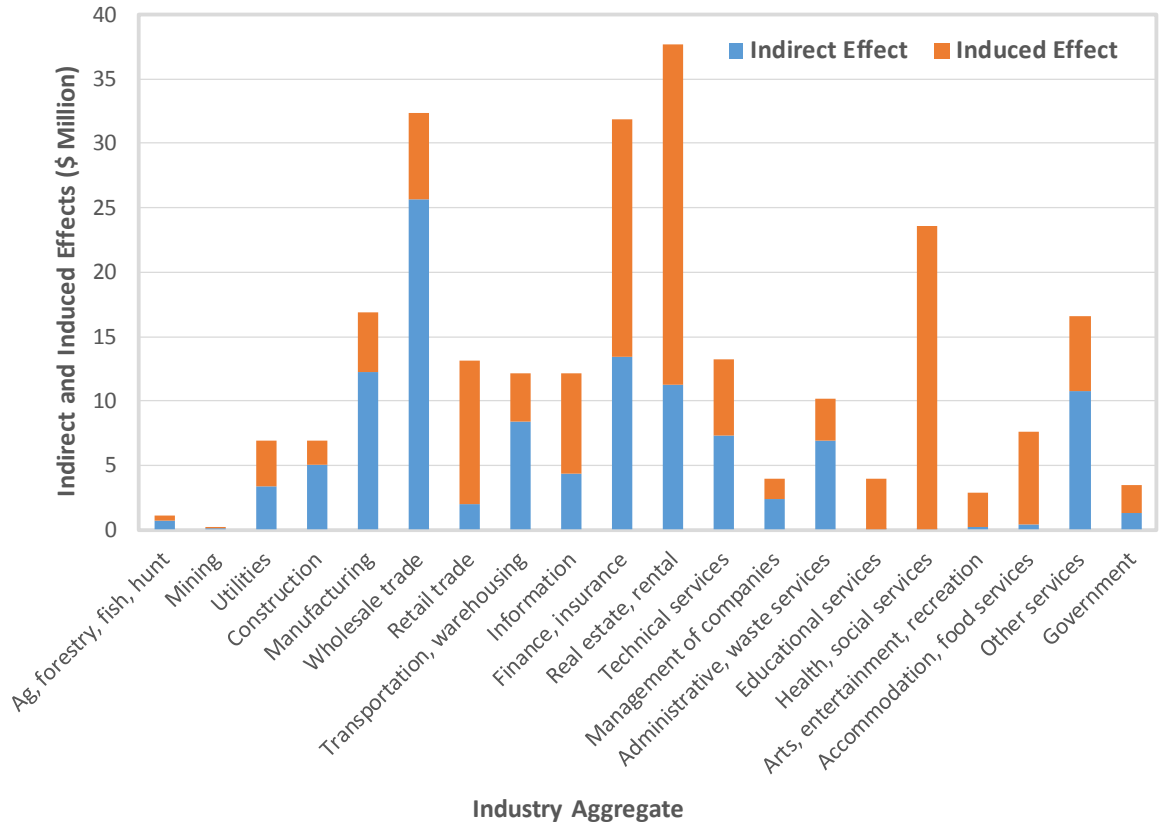


Figure F1. Indirect & induced output effects from apple farming, New York.

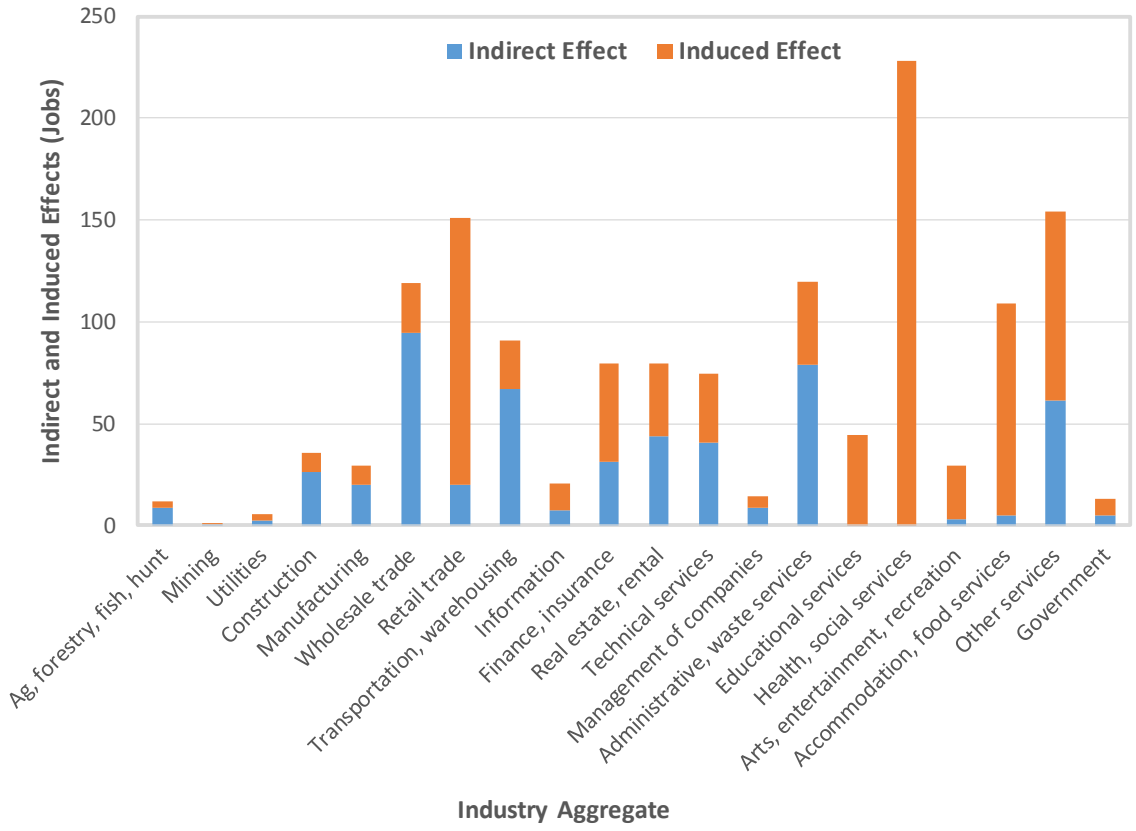


Figure F2. Indirect and induced employment effects from apple farming, New York.

APPENDIX F
DISTRIBUTION OF INDIRECT AND INDUCED EFFECTS: APPLE FARMING AND MANUFACTURING

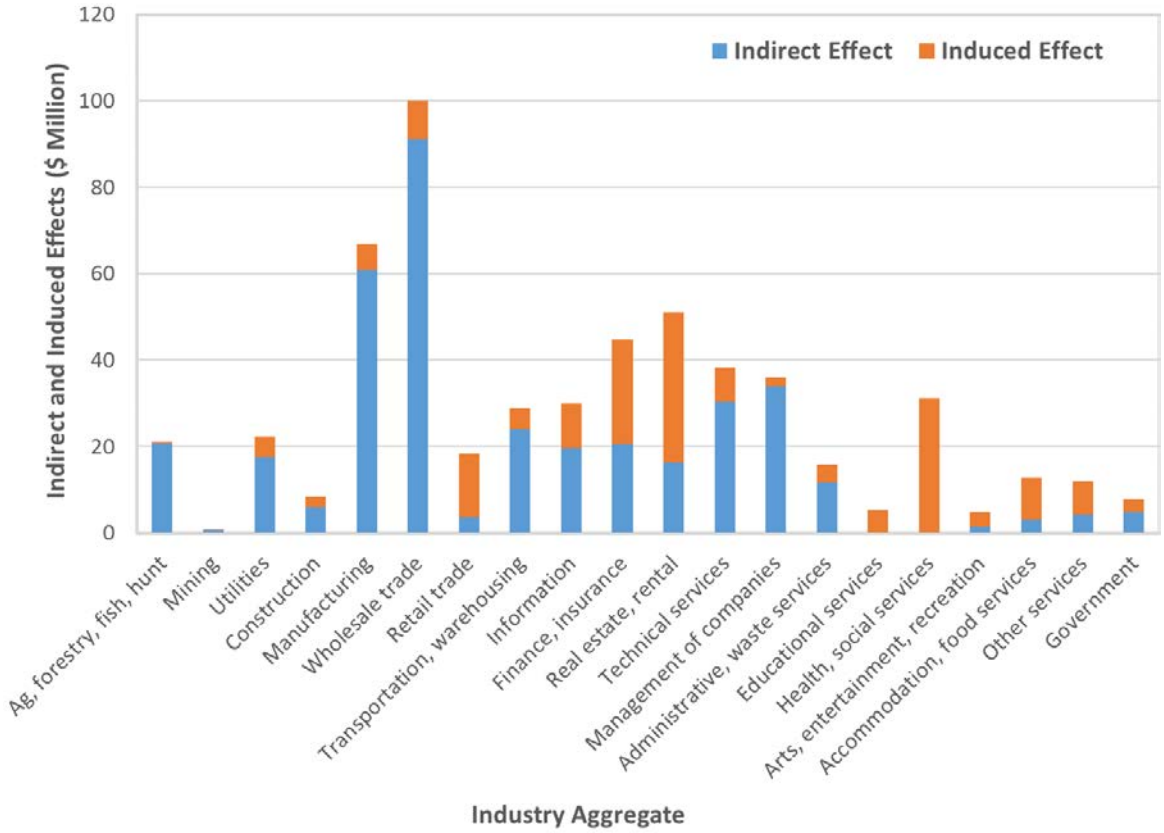


Figure F3. Indirect & induced output effects from apple manufacturing, New York.

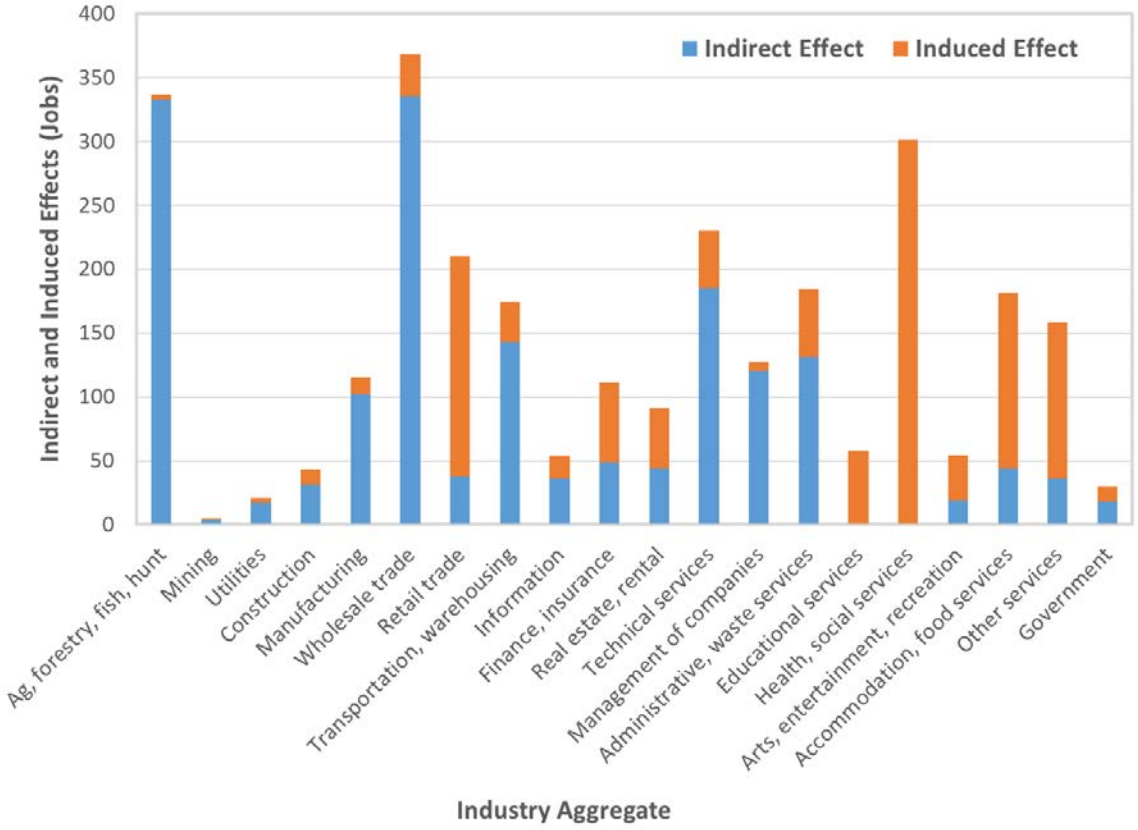


Figure F4. Indirect and induced employment effects from apple manufacturing, New York State.

OTHER A.E.M. EXTENSION BULLETINS

EB No	Title	Fee (if applicable)	Author(s)
2018-03	Economic Contributions of the Apple Industry Supply Chain in New York State		Schmit, T.M., R.M. Severson, J. Strzok, and J. Barros
2018-02	Case Studies of supermarkets and food supply chains in low-income areas of the Northeast: A cross case comparison of 11 case studies		Park, K.S., Gomez, M.I. and K. Clancy
2018-01	Six Year Trend Analysis New York State Dairy Farms: Selected Financial and Production Factors		Karszes, J. and K. Windecker
2017-16	Case studies of supermarkets and food supply chains in low-income areas of the Northeast: Syracuse Store 2, New York		Park, K.S., Gomez, M. and K. Clancy
2017-15	Case studies of supermarkets and food supply chains in low-income areas of the Northeast: Syracuse Store 1, New York		Park, K.S., Gomez, M. and K. Clancy
2017-14	Case studies of supermarkets and food supply chains in low-income areas of the Northeast: Pittsburgh Store, Pennsylvania		Park, K.S., Gomez, M. and K. Clancy
2017-13	Case studies of supermarkets and food supply chains in low-income areas of the Northeast: Onondaga County Store, New York		Park, K.S., Gomez, M. and K. Clancy
2017-12	Case studies of supermarkets and food supply chains in low-income areas of the Northeast: New York City Store, New York		Park, K.S., Gomez, M. and K. Clancy
2017-11	Case studies of supermarkets and food supply chains in low-income areas of the Northeast: Madison County Store, New York		Park, K.S., Gomez, M. and K. Clancy
2017-10	Case studies of supermarkets and food supply chains in low-income areas of the Northeast: Kent Store 2, Delaware		Park, K.S., Gomez, M. and K. Clancy

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